SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY, 1928.

GENERAL PHYSICS.

1. Mass and Weight. M. Grübler. *Zeitschr. f. tech. Phys.* 8. 9. *pp.* 373–374, 1927.

An appreciation of Melchior's paper [see Abstract 2655 (1927)].
G. E. A.

2. Molecular Volumes at Absolute Zero. Part I. Density as a Function of Temperature. Part II. Zero Volumes and Chemical Composition. S. Sugden. *Chem. Soc., J. pp.* 1780–1798. *Aug.*, 1927.

The variation of density with temperature from the freezing point to the critical point was found to be accurately represented for normal liquids by the equation $D - d = D_0(1 - T/T_c)^{3/10}$, where D and d are the densities of the liquid and the saturated vapour respectively at T^0 absolute. The equation held for associated liquids over the lower part of the temperature range, and in some cases nearly to the critical point. The "zero volume" V, obtained by dividing the molecular weight by the constant D, is nearly proportional to the critical volume for a large number of substances. It was shown that the zero volumes could be predicted by adding together certain characteristic constants for the atoms and structures present in the molecule; 284 compounds were considered and 236 were within 2 %, and 149 within 1 %, of the calculated values. Non-polar and semi-polar double bonds were clearly distinguished by their effect upon the zero volume.
F. J. B.

3. Modified Chattock Tilting Pressure Gauge. W. J. Duncan. *Journ. Sci. Instruments*, 4. *pp.* 376–379., *Sept.*, 1927.

A method of avoiding the shift of the zero of the Chattock tilting gauge due to change of temperature is described. The modification of the instrument consists of an additional bulb containing an amount of oil adjusted to secure compensation of the temperature effects.
AUTHOR.

4. Suggestions for the Improvement of Pendulum Observations. C. A. Heiland. *Nat. Research Council, Bull.* 61. *pp.* 66–71, *July*, 1927.

The method suggested for pendulum observations is aimed to dispense with astronomical time-determinations when radio-time signals are received; it does away with flash-boxes and eliminates the visual observations of the moment of coincidence. Measurements at two stations may be made simultaneously, and variations in the rate of the central chronometer during the time of observation are thus eliminated. At the central station an invariable pendulum is used with a lens in the front of the evacuated enclosure. Light passes through the lens to the pendulum mirror, which, when in its central position, reflects the light to a photoelectric cell. The impulse in the photoelectric cell circuit transmits a dot from the central transmitting outfit to the receiving outfits at the stations. These signals are converted into fluctuations of an electric source of light, and the signals of the central and field pendulums are recorded photographically on the same sheet. A special arrangement is used to mark intervals of 10, 20 to 60 seconds on the photographic sheet. Greater accuracy and speed of working are claimed for the method. R. S. R.

5. Electrical Device for the Direct Recording of Acceleration. J. Obata. *Phys. Math. Soc. Japan, Proc.* 9. *pp.* 83–88, *May*, 1927. *In English.*

A pendulum with a massive bob is supported in a nearly vertical position by a rod attached to the bob and pressing on a stretched duralumin sheet. This sheet forms one plate of a condenser in a valve circuit, and the deflections cause changes in the anode current measured by an Einthoven string galvanometer. The horizontal acceleration of the instrument and its frame produces changes in the pressure on the plate, and so in its deflection, and from the galvanometer readings the acceleration can be determined. W. G. B.

6. Some Additional Refinements for Precision Balances. J. J. Manley. *Phys. Soc., Proc.* 39. *pp.* 444–448, *Aug.*, 1927.

This paper deals with certain small errors attendant upon the use of the rider of a precision balance, and shows how such errors may be rendered negligible. Attention is also drawn to some disadvantages resulting from the employment of velvet-covered pan arrestors, and a plan is described for eliminating them. AUTHOR.

7. Device for Studying Mechanical Resonance in the Elementary Laboratory. W. R. Wright and A. H. Croup. *J.O.S.A. and R.S.I.* 15. *pp.* 178–180, *Sept.*, 1927.

Ordinary discussion and standard experiments on resonance demonstrate that the maximum response of a system occurs when the applied force has the same frequency as that of one of the natural modes of vibration of the system. The response at all frequencies, the continuity of the approach to resonance, the effect of friction as well as frequency on the response are factors often left undiscussed. The present apparatus illustrates the elementary meaning of resonance as a special case of forced vibration. The vibrating system consists of two vertical steel knitting needles set side by side into a block. The needles have a natural frequency of 10 vibrations per second, are 1 mm. thick and 10 cm. long. The carrier block is pivoted on a shaft, about which it is made to oscillate by an arm resting on a ball race, mounted eccentrically on a second shaft. The eccentricity is less than 0·5 mm. and the arm 10 cm. long. The second shaft is connected through a variable speed friction drive rotator to a $\frac{1}{4}$-h.p. motor. Examples of actual working curves are given, showing that the method illustrates both the change in the natural period due to the increased mass when a light vane is attached to the vibrator, and also the marked effect of friction upon the response near resonance. Various other effects are clearly shown, and mention is made of the various applications of the apparatus. S. G. B.

8. A Capillary Accelerometer. M. Ishimoto. *Tokyo Univ. Earthquake Research Inst., Bull.* 3. *pp.* 87–103, *Sept.,* 1927. *In French.*

The author discusses two classes of accelerometers and inclines to that of an arbitrary system possessing inertia whose natural period is small compared with that of the applied force under the conditions that (1) the amplitude of the free period is diminished with reference to that of the applied force; (2) the deformation is amplified; and (3) the damping of the free period is sufficiently great to provide that no trace of the free period remains for a discontinuous force. Two types are described giving respectively horizontal and vertical acceleration measurements. The motion of a lead weight supported between two rubber cushions is transferred to the air in an enclosed space and thence to heptane contained in a capillary tube. The movement of this liquid surface is recorded photographically. Curves illustrate the action of the instrument under the conditions required. The apparatus is useful not merely for seismological recording, but also to determine the movements of buildings, bridges, buttresses, etc. R. S. R.

9. A New Viscometer. Albrecht and Wolff. *V.D.I.* 71. *pp.* 1299–1303, *Sept.* 10, 1927.

A new viscometer is described which consists of a pendulum damped by the oil in which it swings. The weight of the pendulum can be varied according to the viscosity of the oil under test, and the damping is recorded photographically on a moving film. The results can be calculated in poises or converted into Engler degrees. The instrument can be used for oils of very small and very large viscosities, and determinations can be made over considerable ranges of temperatures. F. J. B.

10. Capillary Motion of Water in Soils. J. Kozeny. *Akad. Wiss. Wien, Ber.* 136. 2*a. No.* 5–6. *pp.* 271–306, 1927.

A study of the flow of water in soils, considered as a problem of field of force and flow. A. D.

11. Flow Past an Inclined Plate placed between Two Parallel Planes, with Some Applications. T. Sasaki. *Phys. Math. Soc. Japan, Proc.* 9. *pp.* 68–78, *April,* 1927. *In English.*

The problem of *continuous* motion of fluid past a plate inclined to the direction of flow of a stream between two parallel plates is treated by the method of conformal transformation, employing also the theory developed by Villat (Scientia, No. 38). The results are applied to determine the effect of the walls of the tube upon the moment of the force acting on a Rayleigh disc. J. S. G. T.

12. Motion in an Incompressible Fluid where the Lines of Flow are Isotachs. F. Sbrana. *Accad. Lincei, Atti,* 5. *pp.* 876–879, *June* 1, 1927.

Isotachic lines of flow are those in which the velocity is constant. Masotti showed that these must be straight lines or concentric circles.

The author shows that the vorticity is constant along each such line of flow, and that the field of force acting on the elements of the liquid is necessarily conservative. The motion is irrotational only in the case of translation. A. D.

13. Vortex Formation in Fluids. T. Terada and K. Hattori. *Tokyo Univ. Aeronaut. Research Inst. Report,* 2. *pp.* 287–326, *Aug.,* 1927. *In English.*

A continuation of previous work [see Abstract 2750 (1926)] to the study of vortex formation by a rotating disc, sphere and cylinder. Different relative dimensions are studied and combinations of more than one disc and cylinder are employed. The effect of the shape of the vessel is also investigated. J. W. T. W.

14. The Vibrations of an Infinite System of Vortex Rings. H. Levy and A. G. Forsdyke. *Roy. Soc., Proc.* 116. *pp.* 352–379, *Oct.* 1, 1927.

In a previous paper [see Abstract 1968 (1927)] the authors have examined the stability of an infinite system of equal vortex rings situated in parallel planes, and now extend the investigation to the deformation of the vortex filaments. Certain conclusions are drawn regarding natural modes of vibration of the infinite system of vortex rings such as may occur without the longitudinal instability referred to in the previous paper becoming apparent. The equations of motion involve zonal toroidal harmonic functions which are evaluated and tabulated in the paper.

H. H. Ho.

15. Velocity of an Elastic Wave Along the Surface of a Stratified Layer. C. Tsuboi. *Phys. Math. Soc. Japan, Proc.* 9. *pp.* 93–97, *May,* 1927. *In English.*

A somewhat concentrated solution of agar-agar was solidified at the bottom of a rectangular tank, and a more dilute solution poured on top, forming when solidified a stratified layer. The slab was insulated from the walls of the container by cotton wool. A rod passed through the lower layer was made to oscillate, and standing waves were produced on the surface, which enabled their velocity to be calculated. By removing the upper layer, slice by slice, the effect of its thickness on the wave velocity was found. The results can be represented by the formula

$$\log \frac{v - v_1}{v_2 - v} = a\left(\frac{\lambda}{\mathrm{H}}\right) + b,$$

where v_1 and v_2 are the velocities for the upper and lower layers respectively, v the observer velocity, λ the wave-length, and H the thickness of the upper layer. W. G. B.

16. Photoelastic Measurements of Stress Distribution. E. G. Coker. *Roy. Soc. Arts, J.* 75. *pp.* 1017–1028, *Sept.* 9; 1033–1055, *Sept.* 16, *and pp.* 1060–1079, *Sept.* 23, 1927. *Cantor Lectures.*

This series of lectures commences with a discussion of the fundamental principles of photoelasticity and their application to the measurement of stress. Instruments for measuring loads and stresses are described in detail and an account is given of the measurement of stress along the boundaries of plates in which notches are cut. After discussing all the essential features of the photoelastic process, the author shows how to determine the stress distribution along a line of some body taking as a detailed example the loaded curved beam. The substantial accord between theory and experiment encourages the hope of obtaining equally good results by photoelastic means in problems which are at present quite insoluble by theoretical analysis, *e.g.*, the links of chains, piston rings of reciprocating engines, etc. Diagrams of the isoclinics and lines of principal stress of many cases are included. Contact pressures and stresses are next considered and followed by a discussion of thick cylinders. The final lecture was devoted to the testing of materials, the true nature of many of the simple methods in vogue being examined by the photoelastic principles now developed. Among the examples taken are: Distribution of stress in shear specimens, the testing of cement briquettes, stresses in buildings, and the action of cutting tools. The lectures are copiously illustrated by diagrams and plates. H. H. Ho.

17. Elastic Constants of Plate-Shaped Bodies. M. Bergsträsser. *Zeitschr. f. tech. Phys.* 8. 9. *pp.* 355–359, 1927

Two methods for flexure experiments with a parallel strip in pure flexion and with a square plate in pure thrust. Experimental data; in accordance with theory. A. D.

18. Flexure of Thin Cylindrical Shells and Other Thin Sections. L. G. Brazier. *Roy. Soc., Proc.* 116. *pp.* 104–114, *Sept.* 1, 1927.

The present paper indicates the necessary corrections to St. Venant's theory of flexure for cases in which some dimensions of the cross-section are small compared with others. The problem is not attacked by a direct introduction of higher terms in the equations of equilibrium, but by the variational method and the general dynamical theorem that a position of equilibrium will be a position of minimum energy. The body is supposed strained in the manner described by St. Venant, and is then allowed to undergo a system of displacements which are directed so that the applied forces do no work, the condition then being that the strain energy of the body is a minimum. This treatment gives a form of instability under flexure which has not hitherto received treatment, and which is characterised by the absence of a point of bifurcation at which an extensional and an inextensional system of displacements under the given load system become possible. Although only terms of the second order have been introduced, the existence of a maximum bending moment is indicated. H. H. Ho.

19. Small Oscillations of a System About a Position of Stable Equilibrium. P. Appell. *Comptes Rendus,* 185. *pp.* 487–489, *Aug.* 29, 1927.

In a short mathematical study attention is drawn to the case where the function U of the forces, having, after a theorem of Lejeune-Dirichlet, a maximum value for the position of equilibrium, commences with terms of the fourth degree, under which circumstance the oscillations have a duration which depends on their amplitude. A. B. C. L.

20. A Class of Integral Equations Occurring in Physics. D. M. Wrinch and J. W. Nicholson. *Phil. Mag.* 4. pp. 531–560, *Sept.*, 1927.

A mathematical development is presented of the complete class of integral equations of which the Bateman-Herglotz equation is a member, together with their solutions and a discussion of interesting identities which present themselves in a systematic survey. It is remarked that, apart from the utility of equations of the class discussed in connection with problems of seismology and of the diffraction of waves round certain types of obstacle, considerable theoretical importance attaches to the intimate relation shown to exist between them and the fundamental Bessel-Fourier theorems and equations. A. B. C. L.

21. Ballistic Paradoxes. C. Cranz and K. Scheel. *Zeitschr. f. tech. Phys.* 8. 9. *pp.* 359–362, 1927.

Shots do not bury themselves in sand to the greatest depth near the gun, but at a distance of some 300 m.; otherwise with fir-wood. Multiple sounds at a distance near the plane of flight. The penetration of steel plates is greatly aided by a soft steel nose-piece on the tip of the hard steel shell. Lubricating a gun reduces the muzzle velocity. Firing out a stuck bullet by means of a blank cartridge is dangerous to the gun, unexpectedly high pressures being developed. When a steel bullet is splintered against a hard steel target the splinters do not return, but scatter parallel to the plane of the target. Thermoelectric tests show that a blank charge heats the gun not more but less than an equal shotted charge. Shots fired into water or mud fly upwards. The apertures made by an entering bullet vary remarkably with the nature of the substance penetrated. A. D.

22. The Relativistic Mechanics of Holonomous Systems. G. Thomsen. *Accad. Lincei, Atti,* 5. *pp.* 778–782, *May* 15, 1927.

Shows how to apply Hamilton's principle of least action in relativistic mechanics, and offers a mechanical justification for its use. A. D.

23. Structure of Cobalt. S. Sekito. *Tohoku Univ., Sci. Reports,* 16. *pp.* 545–553, *June,* 1927. *In English. Report No.* 167 *of the Research Inst. for Iron, Steel and other Metals.*

An X-ray study of powdered cobalt in a photographic spectrometer of special design. The stable form at ordinary temperatures (α-cobalt) is hexagonal close-packed $a = 2\cdot498$ Å., $c = 4\cdot052$ Å., $c/a = 1\cdot622$, and density = 8·89. Above 477° C. (at 700° C.) the stable form is β-cobalt, face-centred cubic $a = 3\cdot558$ Å., density = 8·64. Electrolytic cobalt is not always a mixture of the two forms. The results are in agreement with the observations of Masumoto on the discontinuity in the elongation-temperature curve. W. H. Ge.

24. Structure of Silicates. W. L. Bragg and J. West. *Roy. Soc., Proc.* 114. *pp.* 450–473, *April,* 1927.

It is pointed out that in many cases crystals of silicates can be regarded as assemblages of oxygen atoms slightly modified by the introduction of silicon and metal atoms. The simplicity of the oxygen structure may be masked by the complex crystal form, but the dimensions of the unit cell may be shown to be related to the spacings of the oxygen atoms. The metallic ions fall into two groups. Those of the first occupy small spaces, and are interchangeable in isomorphous arrangements. They include silicon, aluminium, beryllium, iron and magnesium, while those of the second group, the alkalis and alkaline earths, are of larger size. They are only interchangeable if their sizes are similar and exert a primary influence determining the structure. Detailed discussion of several silicates is given.

A. Wh.

25. Structure of Silicates. W. L. Bragg. *Roy. Inst., Proc. Advance Proof,* [9 *pp*.]. *Received July,* 1927. *Nature,* 120. *pp*. 410–414, *Sept.* 17, 1927.

See also preceding Abstract.

26. Determination of Crystal Orientation in Single Metallic Crystals. Y. Shimizu. *Tohoku Univ., Sci. Reports,* 16. *pp*. 621–625, *June,* 1927. *In English. Report No.* 169 *from the Research Inst. for Iron, Steel and other Metals.*

Describes a rough method for determining the orientation in single crystals of a metal by etching the surface, and then considering the angle of best reflection of light from it. W. H. Ge.

27. Structure of Nematic Melts. W. Kast. *Ann. d. Physik,* 83. 8. *pp*. 1200–1201, *Aug*. 25, 1927.

In a recent paper by the author on melts of para-azoxyanisol [see Abstract 2762 (1927)] some confusion has arisen between the "mosaic crystals," whose size is deduced from the sharpness of the X-ray spectral lines of a solid crystal, and the "lattice blocks" of Smekal. The "nematic elements" which the author has found build up the above melts are of the same order of magnitude as the latter, and generally very much smaller than the former. H. N. A.

28. The Order of Magnitude of the Ideally Built-Up Lattice Regions in Actual Crystals. A. Smekal. *Ann. d. Physik,* 83. 8. *pp*. 1202–1206, *Aug*. 25, 1927.

Calls attention to the high values found for the magnetic moment of certain liquid crystals, which indicate the existence of carriers made up of from 10^4 to 10^5 molecules. The author has, on various grounds, upheld the theory that solid crystals are built up of elements of about this size, in which the molecules are arranged ideally.. A number of facts connected with photoelectric sensitiveness, phosphorescence, and electric conductivity point to the existence of these ideally built structural units. Other phenomena which may depend on them are the change in size of grain in metals due to a small trace of impurity, the fact that the action of Lenard's phosphores depends on an optimum value of the amount of added heavy metal, some of Kohlschütter's topochemical reactions, and perhaps the structure of "high molecular" organic substances. H. N. A.

29. Structure of β-Quartz. E. A. Hylleraas. *ZS. f. Phys.* 44. 11–12. *pp*. 871–886, 1927.

A theoretical paper discussing the equilibrium, positions, double-refraction, and optical rotation of β-quartz, the results of the various X-ray studies of this substance all being considered. W. H. Ge.

30. Investigations on Quartz. A. Meissner. *Phys. Zeits.* 28. *pp*. 621–625, *Sept*. 15, 1927.

Using a circular disc of quartz, cut perpendicularly to one of the three electrical axes, the author has found that two longitudinal vibrations could take place under the influence of high-frequency vibrations of variable frequency. These can be recognised by the strong air currents produced at definite places on the circumference of the plate ; in the plate employed one of them was produced by a 1665-metre wave, and was along a direction inclined at about 71° to the optical axis, the other by a 1160-meter wave, the angle being 48° on the other side of the optical axis. From these facts deductions are made as to the structure of quartz and a model has been constructed. Measurements of piezoelectric phenomena have been made using an electrometer, and others using a double-grid valve and galvanometer. The behaviour of quartz when attacked by hydrofluoric acid confirms the structure arrived at, and the frequencies of the two waves above mentioned agree well with the elastic properties found by Voigt.

H. N. A.

31. Molecular Structure in Solution. Part II. The Refractive Indices and Surface Tensions of Aqueous Solutions of Cobalt Chloride and Hydrochloric Acid. O. R. Howell. *Chem. Soc., J. pp.* 2039–2051, *Sept.*, 1927.

The refractive indices and surface tensions of a series of aqueous solutions containing a constant amount of cobalt chloride and increasing amounts of hydrochloric acid and an exactly similar series containing hydrochloric acid alone are measured. The differences in the values for corresponding solutions bring to light the effect of the acid on the cobalt in solution. The curve showing the differences in refractive index plotted against the concentration of acid is exactly similar to that of the density differences found in a previous investigation (see Abstract 1237 (1927)]. The point of inflexion in both occurs at the same concentration of acid and is accounted for on the same reasoning The curve showing the differences in surface tension is also similar, but has a sharp initial fall and exhibits its point of inflexion at a lower concentration of acid. These two differences are wholly explained by the facts (*a*) that the surface tension is a measure of the conditions prevailing in the surface layer while the other properties are a measure of those in the bulk of the solution, and (*b*) that the relative concentrations of the red and the blue cobalt ions in the surface layer are different from those in the bulk under any given conditions. The change in colour of the cobalt solutions with increasing acid concentration is discussed.

J. N. P.

32. Crystal Structure of Ammonium, Potassium and Rubidium Cupric Chloride Dihydrates. S. B. Hendricks and R. G. Dickinson. *Am. Chem. Soc., J.* 49. *pp.* 2149–2162, *Sept.*, 1927.

As the crystallographic symmetry of most hydrate and ammoniate salts is low for X-ray examination, the authors study the geometrical relationship of the water to the other components in the case of the alkali cupric chloride dihydrates of the type $R_2CuCl_4, 2H_2O$, where R stands for potassium (first studied), ammonium and rubidium. These components crystallise in the ditetragonal bipyramidal class of the tetragonal system. Large crystals showing (111) and (100) were grown from aqueous solutions containing cupric chloride and the alkali chloride in correct proportions, care being taken to select crystals free of twinning on (111). The Laue and spectral photographic measurements, details of which are given, were interpreted on the theory of space groups of Wyckoff [see Abstracts 1205 (1921) and 2003 (1926)] ; the symbols used are not explained in the paper, but reference is made to his book, *Structure of the*

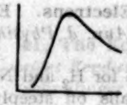
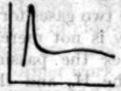
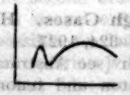
Atoms. By this means the positions of the groups 2Cu, twice 4Cl and twice $2H_2O$ are determined. H. B.

33. Electronic Structure of Atoms. Part I. The Periodic Classification. J. D. M. Smith. *Chem. Soc., J. pp.* 2029–2038, *Sept.*, 1927.

Developing considerations put forward earlier, the author refers the periodicity in the properties of the elements to a corresponding periodicity in the structural complexity of their atoms. The periodic classification is essentially classification by valency types, but the important octet classification has by some workers been obscured by the division of the long periods into unequal periods of odd and even series, and the attempted facilitation of mathematical interpretation of atomic structure has increased the number of groups. The author shows that abridgment, rather than expansion, will clarify the classification and the interpretation of atomic structures. He proposes an abridged periodic classification, distinguishing alkaline, groups I, II, amphoteric III, IV, non-basic groups V to VII, and a zero class VIII, further a transition classification and transition sub-series, all on grounds to be explained in further papers. H. B.

34. Effective Area and Molecular Structure. E. Brüche. *Naturw.* 15. *p.* 408, 1927. *Ann. d. Physik*, 83. 8. *pp.* 1065–1128, *Aug.* 25, 1927.

In continuation of previous work [see Abstract 2461 (1927)] measurements of the effective area with respect to slow electrons have been carried out, using an improved form of Ramsauer's magnetic method, for the following gases: O_2, CH_4, CO, CO_2, N_2O, and NO. The range of electron velocities worked with expressed in equivalent $\sqrt{\text{volts}}$ is 1 to 7. The general variation of the effective area with electron velocity having been determined by a qualitative method, quantitative measurements at a number of points enabled the true curve to be drawn. The Ramsauer Effect is found to occur with all the gases worked with. For high electron velocities the effective area of a compound is obtained as an additive function of those of its constituents, but the present work shows that for

Curve Type.	"External" Electrons.	Gases Investigated.	Investigated by
	8	Ar, Kr, X HCl CH_4 (only indicated for Ne)	Ramsauer Brüche Brode, Brüche Ramsauer
	10	N_2 CO	Brüche in part also Brode
	16	N_2O CO_2	Brüche Brüche

slow electrons the sum rule fails. The gases investigated by the author and others fall into groups, the members of each group having effective area-electron velocity curves of approximately the same shape. The results are summarised in the accompanying table. Oxygen and nitrous oxide give curves which differ from all the types there indicated. Gases in the same group have in common many physical properties and this correspondence has been explained by assuming the number of external electrons to be the same. It is concluded that the number and arrangement of the external electrons, play an essential rôle in determining the way in which the effective area varies with electron velocity. The paper includes a critical discussion of the measurements of other workers in comparison with those of the author. [See also next Abstract.] W. S. S.

35. Effective Area of the CO_2 Molecule with Respect to Slow Electrons. C. Ramsauer. *Ann. d. Physik*, 83. 8. *pp.* 1129–1135, *Aug.* 25, 1927.

An account is given of measurements of the effective area of the CO_2 molecule made in 1920. The electron velocities used corresponded to $0{\cdot}97$ and $1{\cdot}18\ \sqrt{\text{volts}}$. The values obtained are in agreement with Brüche's results [see preceding Abstract] and confirm the sharp rise in the effective area with decreasing electron velocity when the latter falls below about $1{\cdot}4\ \sqrt{\text{volts}}$. It is pointed out that the discrimination between a total effective area and an absorbing cross-section, introduced by the author, which has been used to harmonise discordant experimental results of different investigators, can no longer be said to have experimental support, as Brüche's work has rendered Mayer's measurements doubtful. W. S. S.

36. Effective Area of Ar, Ne, and He for Slow Electrons. E. Brüche, Dorothee Lilienthal and Käte Schrödter. *Ann. d. Physik*, 84. 2. *pp.* 279–291, *Oct.* 4, 1927.

The method is the same as that employed by Brüche for H_2 and N_2 molecules [see Abstract 2461 (1927)]. The Ne curve falls off steeply towards small velocities, and appears to be allied to that of Ar. The curve of Ne resembles that of H_2, and it is suggested that these two gases form a separate group. If this is the case, and the similarity is not merely accidental, it indicates that the field which influences the passing electrons essentially depends on the two electrons of the H_2 and the He molecules. H. N. A.

37. Theory of Passage of Slow Electrons through Gases. H. Faxén and J. Holtsmark. *ZS. f. Phys.* 45. 5–6. pp. 307–324, 1927.

In order to explain the effects observed by Ramsauer [see Abstract 216 (1924)] that slow electrons pass through argon, krypton and xenon without much deflection the provisional assumption is made that the atoms of these gases can be represented by centrally symmetric electrostatic fields. The deflection of electrons by these fields is calculated by means of Schrödinger's wave mechanics. The results obtained indicate that the above effect observed in the case of argon, krypton and xenon is not to be expected for the hydrogen atom. In order to obtain a first approximation for xenon the potential calculated by Thomas [see Abstract 1276 (1927)] for the cæsium atom is taken. This atomic model will give a small deflection for very slow electrons. [See Abstract 2461 (1927)]. A. W.

38. The Actual Content of Quantum Theoretical Kinematics and Mechanics. W. Heisenberg. *ZS. f. Phys.* 43. 3–4. pp. 172–198, 1927.

In this paper exact definitions of place, velocity, energy, etc. (*e.g.*, of electrons), are proposed which are also valid in quantum mechanics, and it is shown that canonical conjugated quantities can only be determined simultaneously with a characteristic inexactness. The latter is the particular basis for the appearance of statistical connections in quantum mechanics. The mathematical formulation has been obtained by means of the Dirac-Jordan theory. From the fundamental propositions so derived it is shown how the macroscopic processes may be understood from the standpoint of quantum mechanics. Special cases are discussed in order to elucidate the theory. H. H. Ho.

39. Wave Mechanics of Matter. T. Takeuchi. *Phys. Math. Soc. Japan, Proc.* 9. *pp.* 66–67, *April,* 1927. *In English.*

Expressions for frequency, the path of matter, and transformation equations for time interval and energy are deduced in accordance with wave mechanics. J. S. G. T.

40. The Characteristic Values of Boundary Value Problems in Wave Mechanics. K. Bechert. *Ann. d. Physik,* 83. 6. *pp.* 905–912, *July* 20, 1927.

Shows that in the simple cases so far investigated the characteristic values (*Eigenwerte*) can be deduced directly from the differential equations, which do not require to be strictly integrated. The paper deals with spherical functions, with the problem of the hydrogen atom, that on a one-dimensional harmonic oscillator, and with the Stark effect. H. N. A.

41. The Equation of Schrödinger. F. Gonseth and G. Juvet. *Comptes Rendus,* 185. *pp.* 448–450, *Aug.* 22, 1927.

Schrödinger, following up ideas published by L. de Broglie in his thesis, has formulated a suggestive theory which is called undulatory mechanics. Schrödinger's ideas can be expressed very simply if the theory of characteristics and bicharacteristics of equations of the second order are employed. The authors in this paper, which is a continuation of former work, bring together the papers of E. Vessiot on the propagation of waves and those of Hadamard in his classical treatises on equations of the second order. An equation being given with partial derivatives of the second order, linear with reference to the second derivatives, it is possible to define multiplicities called "characteristics" by means of an equation with partial derivatives of the first order (J) and of curves called "bicharacteristics" of (O), which are characteristics of (J). If (J) is identified with Jacobi's equation of the movement of a material point, the trajectories of this material point are the bicharacteristics of certain equations (O) amongst which occurs Schrödinger's equation. In an investigation which considers an Einsteinian universe E_4 as a section of a universe of five dimensions E_5 [Abstract 3062 (1927)] an equation for wave propagation is reached which may be identified with Schrödinger's equation. Thus the fiction of a universe of five dimensions enables a deep meaning to be given to Schrödinger's equation. This artifice would become necessary if some phenomenon obliged physicists to believe in the variability of the charge. J. J. S.

42. Schrödinger's Equation and the Equations of Electromagnetism in the Five-Dimensional Universe. F. Gonseth and G. Juvet. *Comptes Rendus*, **185.** *pp.* **535–538,** *Sept.* **5, 1927.**

Continuing the discussion of previous notes [see Abstracts 3062 and 3063 (1927)], the authors investigate the interpretation of the coefficients in the fundamental quadratic form of the five-dimensional universe, specified by $ds^2 = g_{ik}dx^i dx^k + 2\phi_i dx^i dx^4 + \psi^2 dx^4 dx^4$, when all the functions involved have derivatives with respect to x_4, negligible in comparison with those with respect to the coordinates x_0, x_1, x_2 and x_3. The mechanical and electromagnetic equations are derived for this case which corresponds to macroscopic wave mechanics. For the cases which arise in the theory of spectra, different approximations are necessary. **Errata** (*ibid.* p. 732, Oct. 10, 1927). W. S. S.

43. Fresnel's Convection Coefficient in General Relativity. N. R. Sen. *Roy. Soc., Proc.* **116.** *pp.* **73–80,** *Sept.* **1, 1927.**

The usual form of Fresnel's convection coefficient relating to a ray of light travelling in a moving medium is deduced by the application of the principles of general relativity, the medium being assumed to be homogeneous, non-conducting and uncharged. J. S. G. T.

44. Derivation of the Fundamental Relativity Laws from the de Broglie Hypothesis of Phase Waves. A. Haas. *Phys. Zeits.* **28.** *pp.* **632–634,** *Sept.* **15, 1927.**

On the basis of the two conceptions characteristic of de Broglie's theory, (1) that space is filled with groups of waves, group velocity and wave velocity being inversely proportional, and (2) that the energy of these waves is distributed in elements of amount $h\nu$, the following results of relativity theory are established: variation of mass with velocity, the mass-energy equation, formulæ for the longitudinal and transverse masses, and the Lorentz transformation for the time. W. S. S.

45. The Cosmically Stationary Cosmic Equation. T. Okaya. *Phys. Math. Soc. Japan, Proc.* **9.** *pp.* **63–65,** *April,* **1927.** *In French.*

The existence of two scalar densities, H and R, satisfying certain tensor conditions, is postulated, and it is shown that whereas the value of H − R is cosmically stationary in the universe, Einstein's scalar density, H, is stationary only in those parts of the universe where the tensorial density T vanishes completely. J. S. G. T.

METEOROLOGY AND GEOPHYSICS.

46. The Ocean Among the Factors of the Control of Climate. G. W. Littlehales. *Nat. Research Council, Bull.* **61.** *pp.* **26–31,** *July,* **1927.**

Redistribution of mass in the ocean is caused by changes in salinity and temperature. These may be produced in turn by precipitation, evaporation, turbulence and mixing, inflow of rivers, radiation or absorption of heat, or by the action of organisms. General considerations for these factors are examined, and the general oceanic movements at the surface and below are mentioned. The average ocean currents produced by the winds near the main action centres in the northern and southern hemispheres are explained, particularly for the Azores anticyclone and the low-pressure regions near Iceland and the Aleutian Islands. The Gulf Stream movements are given in detail. R. S. R.

LIGHT.

47. The Ultra-Violet Absorption of Simply Built Crystals. R. Hilsch. *ZS. f. Phys.* 44. 6–7. *pp.* 421–430, 1927.

This work attempts to deal with the conditions under which alkali halogen crystals can be made which approach in ultra-violet transparency as near as possible to the best natural crystals. It is necessary to remove the last trace of heavy metals by filtration from the ammonium sulphide precipitate. Artificial KCl was prepared which equalled the best natural sylvite. NaCl artificially prepared was always a little less transparent than the best rock-salt but had a lower absorption coefficient at 186 $\mu\mu$. KBr could be produced which was completely transparent up to 210 $\mu\mu$—its characteristic absorption wave-length. RbCl could be purified till above 200 $\mu\mu$ it showed an absorption coefficient of less than 0·02 mm^{-1}.

J. E.

48. The Coloration of Rock-Salt and of Kuntzite by Becquerel Rays. Berta Zekert. *Akad. Wiss. Wien, Ber.* 136. 2a. *No.* 5–6. *pp.* 337–355, 1927.

The discoloration in the dark of crystals coloured by β- and γ-rays from radium was studied at different temperatures, the alterations in the absorption coefficients for different wave-lengths being determined from time to time. It appeared that the constant of the velocity of discoloration for the most unstable centres followed the van t' Hoff law for velocity of reaction $\log \delta = (-C/T) + B$ in both crystals. The colours observed pointed to a change in the nature of the colour centres during heating. Experiments on the colouring of rock-salt by β- and γ-rays, carried out at different temperatures, confirmed Przibram's theory, the course of the curves obtained for absorption at different wave-lengths indicating that there are several different stable kinds of centre. The saturation values are greatly affected by the temperature, and are reached much quicker at high temperatures.

H. N. A.

49. Total Reflection. A. Rostagni. *N. Cimento,* 4. *pp.* 218–228, May, 1927.

After discussing Raman's recent researches [see Abstract 266 (1926)], the author describes the following experiment in which a fluorescent solution was used as the second medium, the intensity of the fluorescence giving an approximate measure of the penetrating energy. A pencil of voltaic arc light, rendered approximately parallel and limited to an aperture of about 3 mm., passes through a glass prism into a layer of carbon sulphide and impinges at an angle of 60° on the separating surface from a thin superposed fluorescent layer of dilute basic aqueous solution. The effect of the various absorbent media successively traversed—Wood's screen, solution of copper sulphate, ordinary glass and carbon sulphide—is that the radiations of the region round about a wave-length of 390 $\mu\mu$ are predominant. The corresponding indices of refraction are: for water 1·34, carbon sulphide 1·70, so that the relative index of refraction is 1·27 and the limiting angle 51·40. For the maximum wave-length of the visible spectrum the limiting angle would not amount to 56°, so that the conditions of total reflection for all the existing effective radiations are amply fulfilled. Nevertheless, on observing the region of reflection a luminescent patch is clearly discernible. Special precautions were taken to ensure the purity of the carbon sulphide and of the separating surface so as to exclude the possibility of diffraction from particles in suspension. We thus have a direct manifestation of the oscillations traversing the second medium. To estimate in order of magnitude the amount of energy passing into the rarer medium a layer of fluorescent solution of varying thickness, produced by an apparatus for demonstrating Newton's rings, was exposed to the luminous pencil. The intensity of the fluorescence differs in the various regions and increases with the thickness. Mathematical calculation gives results agreeing with direct observation.

E. F.

50. Reflection from Glass. P. Amy. *Rev. d'Optique*, 6. *pp.* 305–315, *Aug.*, 1927.

A series of tests was carried out on various surfaces of glass, some of which had been recently polished and others not so. A parallel beam of light was used, the light being reflected from the surface to be tested and then measured in a photometer. Rayleigh's results on the change of the reflecting power produced by polishing were confirmed. The changes produced by chemical action, when glass was dipped into various solutions, were tested. The reflecting power was found to decrease to a minimum as the length of time in the solution was increased, but with further increase of time the reflecting power increased again. Change of the temperature of the solution produced no effect. The maximum effect is obtained by using cleaned surfaces in a solution of ammonium sulphide diluted with an equal volume of distilled water. Fresnel's theory shows that the polarisation is total for tan $i = n$, where i is the angle of incidence and n the index of refraction. Chemical treatment of the glass surface did not alter this relation.

R. S. R.

51. Shift of Infra-Red Reflection Maxima with Temperature. A. H. Pfund. *J.O.S.A. and R.S.I.* 15. *pp.* 69–73, *Aug.*, 1927.

In modern theories of crystal lattices and specific heats of solids a rôle of great importance is assigned to certain vibrators possessing definite free periods, and tests were made to discover whether or not the frequencies of these vibrators remained constant or were affected by a rise in temperature. The existence of the effect was shown by the behaviour of calcite, fused quartz and glass in the region 6 μ to 10 μ, using an infra-red spectrometer with mirrors of 30 cm. focal length, a rock-salt prism and a vacuum thermopile. A uniform temperature was maintained over the reflector, which was heated by a blast lamp or an electric furnace. The temperature of the surface of the reflector was measured by a Pt, Pt-Rd thermocouple. Curves connecting relative reflection and wave-length were plotted and show (1) a shift of the reflection maxima toward longer wave-length with rise in temperature; (2) a progressive decrease in reflecting power with rise in temperature. (1) is large for glass and quartz but slight for calcite, while (2) is shown by all. Thus there is a change in the periods of oscillations of the vibrators when the temperature is raised. It is suggested that as for ZnO a reflection maximum is made up of a complex of bands which, while remaining unaffected in wave-length, experience a change in intensity with rise in temperature, the change being of greater amount for the longer waves. R. S. R.

52. Relative Deformations of Glass and Fused Silica under the Influence of Temperature Variations. A. Arnulf. *Rev. d'Optique*, 6. *pp.* 316–327, *Aug.*, 1927.

Using an interference method tests were made on slabs of glass and fused silica, the slabs being 20 mm. in diameter, 9 mm. thick and having plane parallel faces. Whether for reflection or refraction the silica has the advantage of a much smaller coefficient of dilatation than glass and a thermal conductivity nine times as great. The effects of heat on one face of the slab were tested to imitate the case of reflection, and of heat throughout the slab to imitate the case of refraction. In the former case the silica is deformed fifty times less than the glass. In the latter case, if steady states are reached, the two substances are practically equally affected, the variation of the refractive index being the predominant factor for silica and dilatation for glass. If temperature changes are rapid silica is less affected on account of its greater conductivity. The objection to the silica is its want of homogeneity and residue of birefringence, and these are against its use for refraction, but it is of most importance for mirrors. R. S. R.

53. Refraction of Light in Gases. J. Tausz and G. Hornung. *Zeitschr. f. tech. Phys.* 8. 9. *pp.* 338–355, 1927.

New method; refraction and dispersion measured in atmospheric air, CO_2, SO_2, methane, ethylene, acetylene, propylene. Dispersion formulæ in these gases (a similar formula for all). Natanson's equation considered and provisional numbers for the dispersion electrons deduced from it. A. D.

54. Refraction and Dispersion of Gaseous Carbon Tetrachloride. H. Lowery. *Phys. Soc., Proc.* 39. *pp.* 421–423, *Aug.*, 1927.

The refractive index of gaseous carbon tetrachloride has been found for the green mercury line (λ5461), the result being expressed in connection with the density of the gas—that is, so as to show the refractivity of the gas by the same number of molecules as 1 c.c. of hydrogen contains at N.T.P. Adopting the value of 1·001799 for the refractive index under these conditions, the dispersion of the gas has been studied over the range λ4800 to λ6700, and is represented by the expression

$$\mu - 1 = \frac{13\cdot543 \times 10^{27}}{7831\cdot7 \times 10^{27} - \nu^2},$$

ν being the frequency of the light. AUTHOR.

55. First Order Laws in Optical Systems. M. Herzberger. *ZS. f. Phys.* 45. 1–2. *pp.* 86–96, 1927.

§ 1 of the paper investigates the characteristic first order magnitudes of an infinitely thin normal pencil of rays. In § 2 it is shown that the above calculations for an optical system lead to the general Sturm formula which is now derived anew. This formula is discussed in § 3, and it is shown that only in the case where the chief ray is the axis of a rotation system can the neighbouring rays of object and image be collinear, and, likewise, that only when the chief ray lies in the meridian plane of a rotation system can such an arrangement exist for rays in the meridian as well as the sagittal sections. §§ 4 and 5 are concerned essentially with the Sturm conoid, as the image of a thin, normal system, and new facts are adduced which condemn the use of this image. It is shown that a normal system whose rays cut a given curve must be arranged rotationally symmetrical about this curve. H. H. Ho.

56. After-Images of Coloured Screens. Winifred J. Smith. *Roy. Soc. Edinburgh, Proc.* **47. 2.** *pp.* **177–189, 1926–1927.**

For after-images of white sources see Abstract 1617 (1925). In the present experiments the sources were various Wratten light filters. The general result was a waning succession of cycles in the order red, green, blue, red, green. . . . Graphical representations are formulated and drawn. A. D.

57. Contribution to the Theory of the Three-Sided Prism. F. Schulze. *Zeits. Instrumentenk.* **47.** *pp.* **417–434,** *Sept.,* **1927.**

The author confines the treatment to the case of a right-angled isoceles triangular prism of relatively small dimensions, and does not deal with the general problem of refraction and reflection when light passes through a prism. He deals with the influence of errors in the angle of the prism and the magnitude of the resultant displacement of the image. Caustics and the position and form of the images are dealt with. The treatment is almost wholly mathematical. R. S. R.

58. A Compact Colour Mixer. J. M. McGinnis and D. S. Piston. *J.O.S.A. and R.S.I.* **15.** *pp.* **117–118,** *Aug.,* **1927.**

To avoid the difficulty of being unable to adjust the coloured discs without stopping the machine the new form of apparatus was devised carrying three discs which can be varied while the machine is in motion. The sizes of the sectors are indicated by arms moving over an attached linear scale. Details are given of the mechanical design, and for the machine it is claimed that it has the advantages of lightness, compactness, and comparatively low cost of construction. R. S. R.

59. Continuously Variable Double Slit. L. E. Dodd and G. H. Jung. *J.O.S.A. and R.S.I.* **15.** *pp.* **181–183,** *Sept.,* **1927.**

Description of a double slit unit of continuously variable distance between the individual slits, for demonstrating the optical principles in the Michelson interferometer for measuring star-diameters, and also for verifying the formula. A. D.

60. Micrometer Microscope equipped with an Illuminated Scale. D. L. Parkhurst. *Frank. Inst., J.* 204. *pp.* 391–393, *Sept.,* 1927.

As triangulation observations are made at night in order to minimise the effects of atmospheric refraction, and as they must be made in nearly total darkness due to the faintness of the signal light upon which the theodolite is pointed, it has been necessary to use a flashlight in reading the micrometer drum. In attempting to get a more suitable device the graduated part of the microscope drum was made in the form of a glass ring frosted on the interior and having a small electric bulb inside it. The graduations thus stand out distinctly, but the frosting stops objectionable glare. With this pattern less time is needed for an observation, and there is less fatigue to the observer's eye owing to changes in brilliancy or focus. The micrometers should be more accurate, as the glass will not warp due to age or changes of temperature. The instrument is used in the U.S. Coast and Geodetic Survey. R. S. R.

61. Correction of Astigmatism in the Rowland Concave Grating. C. Runge and R. Mannkopff. *ZS. f. Phys.* 45. 1–2. *pp.* 13–29, 1927.

A number of methods has been devised for correcting the astigmatism by means of concave mirrors, cylindrical lenses, and, for gratings with large radius of curvature, by a combination of a cylindrical lens and a spherical objective. With the latter it is possible to correct the astigmatism, not only for one wave-length, but for the whole region above 1000 Å. H. N. A.

62. Polarisation of Canal Ray Light. Part II. E. Rupp. *Ann. d. Physik*, 84. 1. *pp.* 94–110, *Sept.* 10, 1927.

In this work hydrogen canal rays at 6000-volt discharge potential are investigated in a mixture of argon and hydrogen at 0·01 mm. and 0·05 mm. Hg pressures, and the results are shown graphically. They are also examined in hydrogen at 0·008 mm. and 0·03 mm. Hg pressure and 6000 volts. In nitrogen they are observed at pressures of 0·008, 0·002 and 0·05 mm. Hg with 8000 volts, and in CO_2 and 0·02 mm. Hg pressure with 7000 volts. The analogy of the polarisation of the canal rays to the polarisation of the resonance fluorescence is considered, and the comparison of the action of the supplementary gases is discussed. [See also Abstract 657 (1927).] A. E. G.

63. Degree of Polarisation of Tyndall Light. R. Gans. *Phys. Zeits.* 28. *pp.* 661–663, *Oct.* 1, 1927.

The usual measurements are inaccurate except where the incident light is a parallel beam. For finite apertures the required corrections are worked out. A. D.

64. Causes of Depolarisation of Light in Disperse Systems. G. I. Pokrowski. *ZS. f. Phys.* 45. 1–2. *pp.* 135–139, 1927.

As has been shown in previous papers, the polarisation of light scattered by coarse disperse systems always falls short of that required by theory. This diminution of polarisation in suspensions is due (*a*) to the varied nature of the particles, and (*b*) to their irregular shape or structure. The same phenomenon in fogs can be explained only by the different size of the elements. With greater concentrations, depolarisation may also be caused by multiple scattering. [See Abstract 1724 (1927).] E. F.

65. Diffraction of Light by a Transparent Lamina. C. V. Raman and I. R. Rao. *Phys. Soc., Proc.* 39. *pp.* 453–457, *Aug.*, 1927.

The present paper embodies an attempt to consider the problem of the diffraction of light by a *very thin* plate of transparent material, bounded by a straight edge, with greater exactness than is attained in the usual elementary treatment on the Fresnel-Huygen principle. The method adopted, though not completely rigorous, bases itself on the electromagnetic theory of light, and seeks to express the disturbance in the field in the form of functions which are solutions of the equations of wave propagation.

The formulæ obtained indicate that the light diffracted by the edge should exhibit colour and polarisation effects varying in a remarkable manner with the thickness of the plate and the direction of observation. Effects having the general character of those indicated by the theory have actually been observed in experiment. The theory, however, requires modification in the case of thicker laminæ, where further complications arise which are not here taken account of. AUTHORS.

66. Interference Fringes in Optical Testing. V. Ronchi. *N. Cimento*, 4. *pp.* 297–314, *July*, 1927.

Gives a theoretical treatment of the use of interference fringes for the testing of optical systems. The second part of the paper describes the application of the method to an actual objective, and mentions the precautions which must be observed. J. W. T. W.

67. Interference and Quanta. G. Wataghin. *N. Cimento*, 4. *pp.* 315–320, *July*, 1927.

It is possible to conceive a quantum of light as being generated by the superposition of a system of electromagnetic waves, plane or spherical. If this be granted, then, whatever be the structure of the quantum, it becomes possible to explain interference. It is also possible to explain reflection and refraction provided the quantum may be divisible. A. D.

68. Anomalous Dispersion in the Potassium Principal Series Lines. W. Prokofiew and G. Gamow. *ZS. f. Phys.* 44. 11–12. *pp.* 887–892, 1927.

The ratio between the dispersion-constants for red and violet doublets is independent of the vapour densities within a range of 1 to 65, and is equal to $111 \cdot 5 \pm 1 \cdot 5$. For still smaller vapour densities it falls by 14 %, which can be explained by the departure of the dispersion from the Sellmeier formula in the neighbourhood of the absorption lines. A. D.

69. Molecular Scattering of Light in a Binary Liquid Mixture. C. V. Raman. *Phil. Mag.* 4. *pp.* 447–448, *Sept.*, 1927.

Referring to a note under this title by K. C. Kar [see Abstract 2024 (1927)], the author points out that the note is based on a misconception. It has not been noticed that the mechanism of the process followed by the author and Ramanathan in their paper published in 1923 is different from that of Einstein and is somewhat simpler. J. J. S.

70. A New Photoelectric Density Meter. F. C. Toy. *Journ. Sci. Instruments*, 4. *pp.* 369–375, *Sept.*, 1927.

The selenium cell type of density meter previously described [see Abstract 213 (1925)] suffers from two defects when densities greater than about 2 are being measured; it becomes slow in action and rather insensitive. The former defect is due to the inherent " lag " of the selenium, and the latter to the small amount of light falling on the cell—a condition which also accentuates its slow action. Without increasing the power of the light source, both of these defects have been eliminated in the machine now described by replacing the selenium cell by a gas-filled photoelectric cell, and utilising all the light which passes through the diffusing opals, instead of only a small fraction of it. This necessitates the construction of a special photoelectric cell having two windows at right angles to one another, but results in a very simple optical system. The photoelectric current is magnified by a valve method, so that a very robust, quick acting, dead-beat galvanometer may be used. The machine is coupled to an automatic curve tracer. AUTHOR.

71. A Photoelectric Process of Half-Tone Negative Making Applicable over Telephone Lines. H. E. Ives. *J.O.S.A. and R.S.I.* 15. *pp.* 96–109, *Aug.*, 1927.

The method of half-tone negative making which is the subject of this paper is a by-product of work on the electrical transmission of pictures, which has been previously described [see Abstract 1811 (1926)]. It uses as its essential apparatus the sending and receiving machines of the telephone picture transmitter equipment. It differs from the methods now employed in making negatives for half-tone engraving in that the negative produced is accurate in its tone values. This accuracy it owes to the proportionality of response to illumination in the photoelectric cell at the sending end, and to the proportionality of light valve opening at the receiving end to the photoelectric current actuating it. In the method here described the dots on the negative are not produced by the spreading of photographic action with exposure in an out-of-focus image, but by the formation of a sharply focussed image of an aperture whose size varies with the tone of the picture. It is thus not dependent on the character of the photographic emulsion used. The tone value of a picture so produced is governed entirely by the relation of the aperture size to the light received from the original picture. The apparatus used in developing the new half-tone negative making method is described. Some discussion of the fields of usefulness of the method is given. A. E. G.

72. Optical Sensitising with Dyestuffs. K. Burgherr. *Z. wiss. Phot.* 24. *pp.* 393–408, *Sept.*, 1927.

Through the play of anodic and kathodic processes, which constitute the essence of photolysis, a stationary condition is reached. A. D.

73. Fogging by Dyestuffs. Lüppo-Cramer. *Z. wiss. Phot.* 24. *pp.* 408–415, *Sept.*, 1927.

Mainly devoted to a restrospect of previous knowledge of the subject and to pointing out various paths for further inquiry. A. D.

74. Microphotography of Opaque Objects at Low Magnification. H. E. v. Gronow. *Z. wiss. Phot.* 24. *pp.* 426–428, *Sept.*, 1927.

Refers to recent work on this subject by F. Kahler [see Abstract 2710 (1927)] and suggests the use of a suitably designed telephoto objective, *i.e.*, an objective allowing the object to be placed at a considerable distance from it. J. W. T. W.

75. The Transparency of Turbid Media. L. Silberstein. *Eastman Kodak Co. Research Lab. Comm. No.* 318. *J.O.S.A. and R.S.I.* 15. *pp.* 125–130, *Sept.*, 1927.

In a previous paper on the transparency of a developed photographic plate [see Abstract 2273 (1927)] it was assumed that the total light scattered by each particle (grain) is sent forward, *i.e.*, in the direction of and under acute angles with the incident light beam. In the present paper the problem of light transmission through turbid media is treated without the above special simplifying hypothesis, but it is assumed that of the light scattered a certain fraction is sent forward and the remainder backward, the numerical value of this fraction being left free. The equations corresponding to this general case are somewhat more complicated but are solved without trouble. H. H. Ho.

76. Light Absorption Measurements. H. v. Halban and J. Eisenbrand. *Roy. Soc., Proc.* 116. *pp.* 153–162, *Sept.* 1, 1927.

This is a critique of existing methods, supplementing the work of Baly, Morton and Riding [see Abstract 1350 (1927)]. It is pointed out that the photographic method is characterised by a small absolute error in extinction, but is entirely suitable for exploring absorption spectra and is much more rapid than the photoelectric method. The latter is, however, much more sensitive to small differences of extinction, especially for strong lines. The cause of the large differences previously found with the two methods at wave-lengths below 3000 Å. has now been traced to the very small transparency of the cell window and the presence of some light of longer wave-length in the monochromator. F. S.

77. Photographic Spectrophotometry in the Ultra-Violet. L. A. Jones. *Eastman Kodak Co. Research Lab., Comm. No.* 314. *Nat. Research Council, Bull.* 61. *pp.* 109–123, *July,* 1927.

Errors may arise due to the intermittency effect if the exposure is not continuous, while the failure of the reciprocity law must also be taken into account. An expression given by Kron is found to agree with experiment. This is of the form

$$E = \frac{I_0 t_0}{2}\left[\left(\frac{I}{I_0}\right)^{a} + \left(\frac{I}{I_0}\right)^{-a}\right].$$

When different wave-lengths also are considered it is found that the value of y (the slope of the density-log exposure curve) varies, and this variation is also dependent on the time of development. Sensitivity of photographic material varies also slightly from point to point, while special methods have to be used to ensure uniformity of development conditions. The method recommended as the result of the foregoing considerations consists in exposing a strip so that the time factor is constant while the intensity varies logarithmically from end to end. A similar strip reversed alongside gives a point of equal density as the reference point. A third strip exposed to the unbroken source matches in density at another point, and the distance of this from the reference point is a direct measure of the intensity ratio. This assumes that the frequency characteristic of the two sources is similar. An application to spectrophotometry in the visible is also described. A. Wh.

78. Correction to a Prevalent Error in Regard to the Data on Photometric Sensibility as a Function of Wave-Length at Low Brightness. I. G. Priest. *J.O.S.A. and R.S.I.* 15. *pp.* 82–84, *Aug.,* 1927.

Attention is drawn to an error which has gained currency in a faulty reproduction of notes descriptive of a diagram due to Koenig and Brodhun. The error is in regard to the departures from Weber's law considered as dependent upon wave-length at low brightness (photometric sensibility). The notes relating to two curves have been transposed, indicating that the ratio of a just-perceptible difference to the stimulus for any given magnitude of the stimulus is greater for shorter than for longer waves, whereas the reverse is the case and was so stated originally. R. S. R.

79. Luminosity of Glow Discharge in Gases. K. Schaum and R. Trautluft. *Z. wiss. Phot.* 24. *pp.* 416–423, *Sept.*, 1927.

Describes experiments on the brightness of the discharge in CO, CO_2 and oxygen in a Siemens tube, *i.e.*, a double-walled tube, the gas flowing between the two concentric glass tubes. The effect of altering the width of the space between the tubes was investigated in the case of oxygen, and it was found that a reduction in the width caused a very marked reduction of brightness. The increase of brightness was in all cases much more rapid than the increase of current in the discharge, but it was less rapid in the case of oxygen, where there was formation of ozone, than in the case of CO and CO_2, where no chemical reaction took place. J. W. T. W.

80. Relative Actinic Power of Light Sources. Colour Temperature of Burning Magnesium. J. M. Eder. *Z. wiss. Phot.* 24. *pp.* 423–426, *Sept.*, 1927.

Collects the available data on relative actinic power, *i.e.*, the relative photographic effect produced by equal amounts of light (measured visually) from ordinary light sources. This is 2·5 for a vacuum tungsten lamp and 15 for magnesium. It is concluded that the colour temperature of burning Mg is in the neighbourhood of 3000° K. J. W. T. W.

81. New Construction of Recording Micro-Photometer. F. Goos and P. P. Koch. *ZS. f. Phys.* 44. 11–12. *pp.* 855–859, 1927.

Since in practice in the measurement of the separation of spectral lines an accuracy of 1 μ is in most cases sufficient, a new pattern of apparatus was devised, less sensitive than earlier ones, but one which could be used quickly and conveniently. The whole apparatus is portable, and measurements are obtained under uniform conditions. R. S. R.

82. The Output of Fluorescence from the K Level for Kα Lines. V. Posejpal. *Comptes Rendus*, 184. *pp.* 1541–1543, *June* 20, 1927.

Obtains a general expression for this output, starting from the assumptions made use of in a previous paper [see Abstract 1763 (1927)]. The equation finally obtained is $1 - u_a/A = KN^6\lambda_a^3$, where u_a is the output, $A = 81/97$ the fraction of atoms ionised in the K level which emit the α line, K a constant of the level and N the atomic number. The values calculated from the formula agree well with the measurements of Harms for Fe, Cu, Zn and Se. H. N. A.

83. Luminescence of Solid Nitrogen under Kathode-Ray Bombardment. J. C. McLennan, H. J. C. Ireton and K. Thomson. *Roy. Soc., Proc.* 116. *pp.* 1–15, *Sept.* 1, 1927.

The phosphorescent spectrum of the light from solidified nitrogen, after irradiation by high-speed electrons from a Coolidge tube with a nickel window, has been shown to consist of two spectral bands designated N_2 and N_4. The band N_2 was found to have the components 5240, 5235, 5229, 5224, 5220, 5214, 5210 and 5204 Å., with 5214 Å. having the greatest intensity. The band N_4 was shown to be composite and to have the components 5944·47, 5938·8 and 5932·0 Å., the strongest being 5944·47 Å. The spectrum of the light emitted by solid nitrogen when under electronic bombardment included, in addition to the bands N_2 and N_4, three diffuse bands, N_1, that shaded into each other and had the mean wave-lengths 5554, 5617 and 5658 Å. This spectrum also included a number of faint diffuse bands, each shaded off towards the red in the blue and violet spectral region between 4573 Å. and 2480 Å. The red band N_3 observed by Vegard [Abstract 2351 (1926)] is not observed by the authors. The moment of inertia of the molecule concerned in the emission of the phosphorescent light is 3×10^{-40}, considerably less than the moment of inertia of the nitrogen molecule when giving rise to the second positive band system. W. V. M.

84. Character of the General or Continuous Spectrum Radiation. W. Duane. *Nat. Acad. Sci., Proc.* 13. *pp.* 662–670, *Sept.*, 1927.

The impacts of electrons against atoms produce too different kinds of radiation—the general, or continuous spectrum, and the line spectra. By far the greatest amount of energy radiated belongs to the general spectrum and not to the line spectra. In the X-ray region, in particular, the general radiation spectrum carries most of the radiated energy. The experiments described in this note deal with the general radiation. The apparatus used is described with the aid of diagrams. A. E. G

85. Plane Waves of Light. T. C. Fry. *J.O.S.A. and R.S.I.* 15. *pp.* 137–161, *Sept.*, 1927.

The author examines the most general solution of Maxwell's equations, for which the magnetic and electric vector components have the form $\phi = \Phi e^{iq(ax + by + cz) - ipt}$. The physical significance of the solution for various possible sets of values of the constants, real and complex, is considered in detail. Several cases not usually given in the textbooks are included. W. S. S.

86. Condition of the Charge of Atoms Previous to the Emission of Light. E. Rupp. *Ann. d. Physik*, 84. 1. *pp.* 154–160, *Sept.* 10, 1927.

Earlier measurements of the charges carried by the alkali atoms [see Abstract 937 (1924)] are here subjected to fresh discussion, and it is shown that the observed displacement of the subordinate series lines in certain conditions can be explained partly by recombination between moving alkali ions and partly by the excitation of stationary alkali atoms by ionic impact. A method is described for determining the charge on atoms previous to light emission. The method is applied qualitatively to hydrogen canal rays, and the results lead to the conclusion that under the conditions of excitation employed a large proportion of the hydrogen atoms are positively charged previous to light emission. A. W.

87. Visible Radiation Arising from Excited Nerve Fibres. Christine Ladd-Franklin. *Comptes Rendus*, 185. *pp.* 584–586, *Sept.* 20, 1927.

Reference is made to the reddish-blue arcs and reddish-blue glow seen in a dark room when looking at a band of red light and which becomes feebler at greater distances. Comparisons are drawn with the emanations from living plants and animals, which can affect photographic plates and it is stated that the nerves probably emit a feeble radiation when at rest which may be beyond the visible spectrum but is transformed by fluorescence when the nerve is stimulated. R. S. R.

88. Depolarisation of Resonance Radiation. P. D. Foote. *Phys. Rev.* 30. *pp.* 300–304, *Sept.*, 1927.

A theoretical discussion of the difference between depolarisation and quenching of resonance radiation and of the various causes producing these effects. F. S.

89. Transmission Properties of Some Filters. E. Pettit. *Mt. Wilson Observat. Contrib. No.* 336. *Astrophys. J.* 66. *pp.* 43–58, *July*, 1927.

The determinations between $\lambda 0 \cdot 23$ and $0 \cdot 45\,\mu$ were made photographically with a 1-m. concave grating spectrograph; those to the red of $\lambda 0 \cdot 45\,\mu$ were made with a monochromatic illuminator and vacuum thermocouple. A table of wave-lengths of easily recognised features of absorption spectra is given for the region $\lambda 0 \cdot 74$ to $2 \cdot 1\,\mu$, which may be used where accuracy greater than $0 \cdot 01\,\mu$ is not required. The transmission curves of 44 filters are given from $\lambda 0 \cdot 23$ to $2 \cdot 3\,\mu$, and in several cases to greater wave-lengths in the infra-red. The effect of sunlight on green celluloid, glass, silver, and gold films has been studied. Solarised green celluloid is a valuable filter transmitting the infra-red with an efficiency of 80–90 %, has a sharp cut-off at $\lambda 0 \cdot 7\,\mu$, and transmits nothing from this point to $\lambda 0 \cdot 23\,\mu$. AUTHOR.

90. Spectra of Doubly- and Trebly-Ionised Titanium (TiIII and TiIV). H. N. Russell and R. J. Lang. *Mt. Wilson Observat. Contrib. No.* 337. *Astrophys. J.* 66. *pp.* 13–42, *July*, 1927.

The lines of trebly-ionised titanium (TiIV) are peculiar to the spectrum of the vacuum spark. Those of TiIII appear in the ordinary spark, but are much enhanced in the vacuum source. Thirty-one lines of TiIV and 90 of TiIII have been identified. All of the former and most of the latter are new. Tables of wave-lengths and intensities based on plates obtained at Mt. Wilson and Edmonton are given. The wave-lengths range from 5492 to 423 Å. All the lines of TiIV and all but four of TiIII have been classified. The spectrum of TiIV is very regular and consists entirely of doublets, arranged in series conforming to the Ritz formula. Twelve lines, of types ranging from S to H, have been identified and are tabulated. The 3D term is the lowest, and the ionisation potential is 43·06 volts. The doublet separations are in excellent agreement with Landé's formula. The spectrum of TiIII includes triplet and singlet terms and is closely analogous to that of ScII. Nineteen terms, of types ranging from S to G, have been identified. The lowest term is of type ^{3}F, followed by ^{1}D, ^{3}P and ^{1}G. The observed terms are in perfect agreement with Hund's theory, arising from the electron configuration $(3d)^2$, $3d \cdot 4s$, $3d \cdot 4p$, $3d \cdot 4d$, and $4s \cdot 4p$. The estimated ionisation potential is 27·6 volts, with an uncertainty not exceeding 1 volt. The term separations are again in general agreement with Landé's formula. The spectrum of ScIII is also briefly discussed. One new term is added (5S). All the strong lines of the spectrum which have not been observed must lie in the visible region. Their predicted positions are given. Comparisons are made between the series spectra, KI, CaII, ScIII, and TiIV, and also CaI, ScII, and TiIII. Moseley's law, as extended to the optical region, is fully verified, the differences in $\sqrt{\nu/R}$ being practically constant for similar terms from one spectrum to the next. The identifications of certain doubtful terms are thus confirmed. AUTHORS.

91. Series in the Spectrum of Trebly-Ionised Tin (SnIV). K. R. Rao. *Phys. Soc., Proc.* 39. *pp.* 408–416, *Aug.*, 1927.

The paper gives particulars of regularities observed in the spectrum of tin corresponding to the trebly-ionised stage of the element. Pairs of sharp and diffuse series are discovered which converge to a common limit with a sixteen-fold value of the Rydberg constant. The fundamental and super-fundamental series doublets are also indicated. Term values are evaluated from the related system of members by assuming a value for the term "G." Great efforts have been made in the determination of the wave-lengths of the lines of the tin spark spectrum. The plates were finally measured from spectra taken in the second order of a 5-ft. concave grating and an accuracy to about 0·05 Å.U. is claimed. The experimental method of sorting out the lines due to this high stage of ionisation (SnIV) is the same as that adopted previously by the writer in the case of Sn, Ga, In. [See also Abstract 2060 (1927).] AUTHOR.

92. Absorption Spectra of Mercury, Cadmium and Zinc at High Pressure. F. L. Mohler and H. R. Moore. *J.O.S.A. and R.S.I.* 15. *pp.* 74–81, *Aug.*, 1927.

Absorption spectra of mercury, cadmium and zinc vapours have been photographed with a quartz spectrograph using absorption cells containing vapour at pressures ranging up to several atmospheres. The spectra are characterised by wide regions of continuous absorption and series of flutings and diffuse bands. Some of these have been previously observed in emission. The flutings may be interpreted as poorly resolved band systems of diatomic molecules in which the excited electronic state is much more stable than the normal state. It is possible to account for the long duration of fluorescence by assuming that first the molecule is raised to a high vibration state by absorption and that consequently by a collision of the second kind it drops to a low vibration state having a very small emission probability. AUTHORS.

93. Absorption and Fluorescence of Silver Bromide and Silver Chloride Vapour. J. Franck and H. Kuhn. *ZS. f. Phys.* 44. 9–10. *pp.* 607–614, 1927.

The absorption and fluorescence of AgBr and AgCl vapours has been investigated in the same way as was previously described for AgI. The spectral positions and structures, as well as the relative sizes of the nuclear vibration quanta derived from resonance lines, show that AgBr and AgCl, as well as AgI, have atomic linkages in the gaseous state. This is confirmed by the variations of vibration quantum numbers. AgF may have an ionic structure. W. V. M.

94. Absorption Spectra of Aragonite and Strontianite in the Near Infra-Red. F. I. G. Rawlins and E. K. Rideal. *Roy. Soc., Proc.* 116. *pp.* 140–152, *Sept.* 1, 1927.

This is an extension of earlier work [see Abstract 1034 (1927)], made with a Littrow-pattern infra-red instrument and modified Boys' radiomicrometer. Two samples of different thicknesses were used for each material. Two allotropic modifications of $CaCo_3$ have been compared, as well as a series of biaxial crystals of the carbonates of Ca, Sr, Ba. Definite displacements of the three fundamental frequencies of the CO_3^{--} ion occur in the two crystal forms. From the overtones of the fundamental at 7 μ it is shown that the frequencies do not follow the order ν_1, $2\nu_1$, $3\nu_1$, but that a correction analogous to the Kratzer correction must be used. In the biaxial crystals the absorption at ν_1 (7 μ) increases with molecular volume, but the reverse is the case for bands at ν_2 (14 μ) and ν_3 (11 μ). F. S.

95. Ultra-Violet Absorption of Dichlornaphthalene. H. de László. *Comptes Rendus,* 185. *pp.* 599–601, *Sept.* 26, 1927.

Tables and curves of the intensities of absorption bands of the ten isomers of dichlornaphthalene are given. All the spectra, with the exception of (1 — 2), show an electronic interval of about 1420 cm.$^{-1}$, which is most clearly marked for the derivatives $\beta\beta$ and $\alpha\beta$. F. S.

96. Absorption Spectra of Some Phosphorescent Alkali Halogenides to which Thallium and Lead are Added. R. Hilsch. *ZS. f. Phys.* 44. 11–12. *pp.* 860–870, 1927.

Earlier experimenters with phosphorescent crystals were handicapped by the minuteness of the crystal used and by the fact that the absorption of the basic material masks or overlaps that due to phosphorescence. By using alkali halogenides, larger crystals are available, while by adding Tl or Pb to the basic material the selective absorption bands of the phosphorescent crystals are removed from the true ultra-violet absorption of the basic materials. Absolute purity of the materials used in preparing the crystals is emphasised. Results were obtained for Tl and Pb added to NaCl, KCl, RbCl, NaBr and KBr, and are illustrated diagrammatically and in a table. It was shown that (1) the structures of the alkali halogenides were not affected by the Tl and Pb kations to an equal extent, (2) the absorption spectra were distinct and made up of two separated sharp bands, (3) the kation of the basic material has a quite subordinate influence on the form and position of the absorption bands, and (4) a change of the anion in the basic material from Cl to Br to I displaces the absorption spectra towards longer wave-lengths. R. S. R.

97. Absorption Spectra of Alkali-Halides. A. Smakula. *Zs. f. Phys.* 45. 1–2. *pp.* 1–12, 1927.

Phosphorescent crystals can be obtained by the addition of a small quantity of a foreign metal to the alkali halides. When light is passed through, an absorption takes place, and this is observed spectrophotometrically. The author deals with salts having silver and copper as the impurity added. It is found that selective absorptions occur for the following crystals at the given respective wave-lengths :—

NaCl + Ag at 210 $m\mu$	NaBr + Ag at 219 $m\mu$
NaCl + Cu at 255 $m\mu$	NaBr + Cu at 259 $m\mu$
KCl + Cu at 265 $m\mu$	KBr + Cu at 265 $m\mu$

AgCl alone absorbs first at about 250 $m\mu$. NO_3, introduced as $AgNO_3$, produces two characteristic absorption bands, which, however, do not contribute to the phosphorescence. A. C. M.

98. Instantaneous Spectrograms of Elements. H. Nagaoka, D. Nukiyama and T. Futagami. *Imp. Acad. Tokyo, Proc.* 3. *pp.* 392–418, *July,* 1927. *In English.*

A continuation of previous work [see Abstract 694 (1927)]. The elements dealt with in the present communications are C, Si, Sn, Pb, Ce, Sb, Bi, Mn, Cr, Mo, Te, Fe, Co, Ni, Pd, Ir and Pt. Tables of wave-lengths, intensities and emission intervals are given, and a number of spectra are reproduced. F. S.

99. Spark Spectrum of Nickel (NiII). A. G. Shenstone. *Phys. Rev.* 30. *pp.* 255–265, *Sept.,* 1927.

The analysis of the spark spectrum of nickel shows that the important atomic structures are d^8s and d^8p. The low set of terms comprises $^4F'$, $^2F'$, $^4P'$, $^2P'$, ^2D, ^2G, of which $^4F^{5'}$ is lowest. The only expected term from the structure d^8s which has not been found is ^2S. All the intermediate terms (d^8p) have been found with the exception of a ^2P and a doubtful ^2F and $^2S'$. A higher member of the $^4F'$, $^2F'$ series (d^8, s) has been found and indicates an I.P. of 17·4 volts from d^8s to d^8. The expected lowest term, $^2D(d^9)$, has not been found. Terms are inverted with the following exceptions: (1) $a^4G^{6'}$ is higher than $a^4G^{5'}$; (2) $a^4P^{3'}$ is higher than $a^4P^{1'}$; (3) $b^4D^{4'}$ is higher than $b^4D^{1'}$; (4) triad b^9P, D', F is not inverted. Zeeman effects give some irregular g-values, but the g-sum rule is apparently satisfied. The g-sum rule is found to be not confined to terms built on the same ion term. AUTHOR.

100. The First Spark Spectrum of Aluminium (AlII). R. A. Sawyer and F. Paschen. *Ann. d. Physik,* 84. 1. *pp.* 1–19, *Sept.* 10, 1927.

Paschen has previously given [see Abstract 2419 (1923)] the series analysis of the triplet system of the spectrum of AlII. The method now employed is briefly discussed and the following tables of results are given: The term system of AlII; wave-lengths of AlII in an atmosphere of helium with aluminium cylindrical kathode. The vacuum spectrograph; a comparison of the AlII singlets with MgI and hydrogen. A. E. G.

101. Emission of Light from Hydrogen Atoms. R. d'E. Atkinson. *Roy. Soc., Proc.* 116. *pp.* 81–103, *Sept.* 1, 1927.

Wien's hypotheses [see Abstract 1441 (1923)] concerning the observation that when a beam of canal rays passes into a vacuum the light-intensity falls exponentially to a constant value are first discussed. Experiments are then described in which a non-luminous beam of canal rays was made to emit the Balmer lines by excitation at approximately one point only. The distribution of the intensity was measured photographically and compared, near the maximum, with that to be expected on the assumption that the intensity due to a strict point-excitation would begin at the point and would fall off exponentially from the start. The agreement obtained supports this assumption. Several considerations arising out of this result are discussed, including some suggestions as to the nature of the excitation process; and some further experiments made possible by the success of the method are outlined—in particular a proposal for observing the "negative radiation-effect" postulated by Einstein. An addendum discusses articles by Sugiura [see Abstract 2280 (1927)] and Wien [see Abstract 2522 (1927)] which, taken together, answered many of the questions raised and correct some false assumptions. The process of excitation surmised in the paper is held to be correct, *viz.*, an instantaneous placing of the hydrogen ion (or atom) into a definite and preferably fairly deep quantised state; but the apparent directness of canal-ray determinations of decay-times is illusory. H. H. Ho.

102. Intensity Distribution Among the Lines of Certain Bands in the Spectrum of the Hydrogen Molecule. O. W. Richardson. *Roy. Soc., Proc.* 116. *pp.* 484–491, *Oct.* 1, 1927.

Using his own measurements and those of McLennan, Grayson Smith and Collins, the author arrives at the conclusion that in the Q branches, which are the strongest, the lines Q(1), Q(3) and Q(5) are related in intensity to the intermediate Q(2) and Q(4) lines, the mean value of the intensities of two consecutive odd-numbered lines being nearly three times as great as that of the intermediate line. The relation is, in many cases, masked by the more or less close coincidence of some other spectral line with the even numbered one. Considers the theory of the phenomenon, and arrives at formulæ for the intensities of the odd and even lines respectively. The stronger states are those which have the same weights and rotational quantum numbers as the antisymmetric states of Hund, and the weaker ones agree with the symmetric states. The author concludes that the antisymmetric molecules are three times as numerous as the symmetric ones. H. N. A.

103. Analysis of the Hydrogen Band Spectrum in the Extreme Ultra-Violet. T. Hori. *ZS. f. Phys.* 44. 11–12. *pp.* 834–854, 1927.

Deals both with the recently discovered Werner bands [see Abstract 1022 (1927)] and with the Lyman bands. A number of new measurements of wave-length and intensity have been made and are tabulated; the effect of temperature and pressure on the bands has been studied, and that of the latter has been found to be very great and very irregular in the case of the Werner bands. The analysis of the rotation lines for both band systems has been carried out on the basis of Dieke and Hopfield's term scheme for the H_2 molecule [see Abstract 1387 (1927)]. The lines of the Werner bands have been arranged along P, Q and R curves, the formulæ for which are given. For the Lyman bands the Q and P branches fall together. It is necessary to assume that the terms of the initial states are split up into two. The moment of inertia in the normal state is equal to $4 \cdot 67 \times 10^{-41}$. H. N. A.

104. On the Content of the Light Emission from Hydrogen Canal Rays by their Passage from an Electric Field into a Field-Free Space. H. R. v. Traubenberg and R. Gebauer. *ZS. f. Phys.* 44. 11–12. pp. 762–768, 1927.

Attempts to solve this problem have now been renewed [see *Phys. Zeits.* 25. *p.* 607, 1924] with improved apparatus. This is fully described in the present paper, and the influence of the field on the fine structure components is recognised and discussed. H. H. Ho.

105. Doublet Separation and Fine Structure of the Balmer Lines of Hydrogen. N. A. Kent, L. B. Taylor and Hazel Pearson. *Phys. Rev.* 30. *pp.* 266–283, *Sept.*, 1927.

Using two optical trains, (1) two crossed Lummer plates, the larger of resolving power of about 670,000, and (2) an echelon of resolving power of about 660,000, the writers have determined the wave-length difference between the two well-known components λ' and $\lambda''(\lambda'>\lambda'')$ of Hα, Hβ and Hγ as 0·1370, 0·0791 and 0·0666 Å. respectively. These values are in good agreement with those obtained by Houston with an interferometer, which are, in our estimation, the most reliable thus far obtained. Further, microphotometer curves of enlargements of the original Lummer plate negatives reveal another component in λ' unresolved but unquestionably present, in Hα, Hβ and Hγ. Hansen noticed asymmetries here in Hα and Hβ. There are also indications of other components in λ''. The magnitudes of these components agree well with the theoretical magnitudes given by the new quantum mechanics with the spinning electron. AUTHORS.

106. Intensity Ratio of the Blue Cæsium Doublet. C. F. Hagenow and A. L. Hughes. *Phys. Rev.* 30. *pp.* 284–299, *Sept.*, 1927.

The rule of Burger and Dorgelo leads one to expect a ratio of 2 : 1 for the intensities of the members of the blue doublet of cæsium (4555, 4593 Å.), a ratio which is in agreement with some experimental determinations and in disagreement with others. The new method of measuring intensities of spectral lines developed by Merton was employed in this investigation. The results gave ratios ranging from 2·3 : 1 to 3·8 : 1, the higher ratios being obtained with more attenuated sources where one would expect from Burger and Dorgelo's rule an asymptotic approach to the 2 : 1 ratio. As a check on the method the 2 : 1 ratio generally accepted for the potassium doublet (4044, 4047 Å.) was verified. AUTHORS.

107. Regularities in the Spectrum of Ionised Neon. P. K. Kichlu. *Phys. Soc., Proc.* 39. *pp.* 424–428, *Aug.*, 1927.

A number of lines lying between λ7282 and λ3142 occurs in the condensed discharge spectrum of the more volatile gases of the air. These have been attributed to singly ionised neon, and the present paper comprises an analysis which confirms this view. AUTHOR.

108. Intensities in the Helium Spectrum. L. S. Ornstein and H. P. Bouwman. *ZS. f. Phys.* 43. 11–12. *pp.* 839–844, 1927.

The intensity of a spectral line depends upon the number of electrons which collide with gaseous atoms, and therefore it is dependent upon the current in a discharge. With this in mind the authors have measured the intensities of certain helium lines when various values of the current are employed in a condensed discharge. The arc lines 2S — 3P, 2P — 4D, 2*p* — 4*s*, 2P — 5P all behave in the same way as regards intensity when the current is varied. They rise in intensity with increasing current, reach a maximum, fall to a minimum at about the same value of the current, and again rise in intensity. The spark line λ4686, however, rises fairly continuously in intensity. A. C. M.

109. Structure of the Calcium Fluoride Band λ6087. S. Goudsmit. *K. Akad. Amsterdam, Proc.* 30. 3. *pp.* 355–361, 1927.

Using a grating giving a greater dispersion than that used by Danjon, measurements are made of the anomalous intensity effects of the band λ6087 to ascertain whether Danjon's explanation still appears to be correct. Experimental difficulties in finding a suitable source of light are described. Owing to the diffuseness of the lines the measurement can be made better with the photometer than with the comparator. The view is held that the band regarded by Danjon as a single band is in reality a group in which the successive bands are superposed, the lines from the different bands coinciding and thus presenting the appearance of a continuous band. A formula expressing the results is developed, but it is not considered that the bands present a normal structure.

A. B. C. L.

110. Fine Structure of Lanthanum Lines. W. F. Meggers and K. Burns. *J.O.S.A. and R.S.I.* 14. *pp.* 449–454, *June*, 1927.

Lanthanum chloride or oxide mixed with powdered graphite was put as a core into a carbon rod, and served as the lower electrode of an arc, operated with 10 amperes at 220 volts, the residual gas pressure being about 5 cm. of mercury. The fine-structure was examined with a resolving-power of the order of 150,000, and the region studied was from λ3800 to λ6000. About 30 % of the lines are complex. The present paper is to be regarded as a preliminary report. The complex levels are apparently the low metastable states. The various levels of a polyfold term have very distinctive fine-structure features, *e.g.*, $^{4}\overline{\mathrm{F}}_{2}$ in LaI is a quartet, $^{4}\overline{\mathrm{F}}_{3}$ is single or very closely packed, $^{4}\overline{\mathrm{F}}_{4}$ is double, and $^{4}\overline{\mathrm{F}}_{5}$ has not yet been fully resolved (suspected of being quadruple). Apparently levels are split up into complex sub-levels if they are due to a configuration possessing one *s*-electon (provisional). Russell suggests that the effect may be due to a spinning proton. [See also Abstract 2296 (1927).]

A. C. M.

111. Intensity of Spectral Lines. G. I. Pokrowski. *ZS. f. Phys.* 45. 1–2. *pp.* 140–145, 1927.

The connection between the intensity of the spectral lines in spark and flame spectra and the concentration of the emitting matter is here experimentally and theoretically examined for cases in which the concentration is small. It is shown that with increasing concentration the light absorption of the emitting medium may cause an "apparent" widening of the lines, in contradistinction to the "actual" widening due to the combined action of the emitting centres. The possibility of a quantitative spectrum analysis on the basis of these phenomena is discussed. The paper contains several curves and is partly mathematical.

E. F.

112. Natural Breadth of the D Absorption Lines and their Broadening with Increased Density of the Sodium Vapour and with the Pressure of Added Gases. W. Schütz. *ZS. f. Phys.* 45. 1–2. *pp.* 30–66, 1927.

Determines experimentally the relation between the Righi effect and vapour pressure and pressure of added gas, and uses the results, in connection with Voigt's treatment of the effect, to deduce a theory by means of which the half value breadth of spectral lines can be determined from the measured relation between the above pressures and the magnetic field intensity. As results the natural breadth of the D lines is found to be the constant limiting value of the line breadth for vapour pressures $p < 4 \times 10^{-3}$ mm., the mean value agreeing with the classical one $W_0' = 0{\cdot}64 \times 10^{8}$ sec.$^{-1}$; the previously found relation between the broadening of the lines and the vapour pressure has been quantitatively confirmed, and the law for the broadening by addition of gases (He, Ne, A, N_2, H_2) has been deduced. The Lorentz collision theory is confirmed with respect to the proportionality to pressure, the form of the lines and the absolute amount of broadening. The experimental results are discussed in relation to the existing literature on the subject. H. N. A.

113. Optical Dissociation of Salt Molecules. A. Terenin. *ZS. f. Phys.* **44.** 9–10. *pp.* **713–736, 1927.**

On illuminating diluted vapours of diatomic halogen salts with ultraviolet light beyond a certain frequency there is a powerful emission of lines proper to the metallic atom; there is a primary dissociation of the salt molecule into halide and metal atoms, the latter excited, the former not. Triatomic halogen salt molecules (*e.g.*, $HgCl_2$) impinged upon by ultra-violet light within certain ranges of frequency give an intensive emission of bands, which are independent of the impinging wave-length; there is primary dissociation into an unexcited binary (MX) and a halogen atom (X), which may be excited or not. A. D.

114. X-Rays of Long Wave-Length from a Ruled Grating. F. L. Hunt. *Phys. Rev.* 30. *pp.* 227–231, *Sept.*, 1927.

By the use of a grating ruled on glass (200 lines per millimetre) at grazing incidence (20′ to 40′) in vacuum, the following lines have been obtained: Mα of platinum (6 Å.); Kα of aluminium (8·3 Å.); Lα of copper (13·3 Å.); Lα of iron (17·7 Å.); Lα of chromium (21·5 Å.); Kα of carbon (45·8 Å.). A water-cooled metal X-ray tube with a hot lime-coated platinum kathode was used. This was connected directly to the spectrometer with no absorbing film between the antikathode and the photographic plate. Wave-lengths were determined with reference to Lα of copper and also directly by calculation from the constants of the spectrometer. AUTHOR.

115. Experimental Study of the Relative Intensities of X-Ray Lines in the L-Spectrum of Thorium. S. K. Allison. *Phys. Rev.* **30.** *pp.* **245–254,** *Sept.*, **1927.**

The relative intensities of the thorium L-series lines have been measured at 31·8 kV using an ionisation chamber spectrometer. In addition to the lines previously reported by other investigators, the lines ThLη, ThLβ_7, ThLγ_2 were found, but no indications of ThLγ_5 or ThLγ_4. The relative intensities have been corrected for absorption in the mica windows and air in the path from the X-ray tube to the ionisation chamber, and for the fraction of the radiation absorbed in the methyl iodide in the latter. It was found that in the voltage range between the critical excitation voltage V_0 and 31·8 kV, the intensity of ThLα_1 or ThLβ_{15} at any voltage V could be expressed by $I = k(V - V_0)^2$ within the limits of experimental error. Using this expression the relative intensities at 31·8 kV were extrapolated to the relative intensities at high voltage, to which it was assumed the theoretical predictions apply. The intensity rules for doublets hold for lines involving the levels L_{21} and L_{22}. The predictions of Wentzel based on Schrödinger's new quantum mechanics for the relative intensities of "sharp" and "diffuse" series doublets are confirmed, but the experimental intensities of the "principal" series doublets are too low by a factor of 7. They are also too low in the measurements of Jönsson on tungsten. The results obtained are as follows :—

Line.	l.	α_2.	α_1.	η.	β_6.	β_2.	β_7.	β_1.	β_3.	γ_5.	γ_1.	γ_2.	$\gamma_3 + \gamma_6$.	γ_4.
Rel. Int. (32 kV)	3·6	12	100	1·1	1·4	26	0·45	38	1·8	0	8·5	0·81	3·1	0
Rel. Int. (high voltage)......	3·6	12	100	1·8	1·4	26	0·45	62	3·3	0	14	1·5	5·3	0

AUTHOR.

116. Higher Multiplets in the X-Ray Spectrum. J. H. van der Tuuk. *ZS. f. Phys.* 44. 9–10. *pp.* 737–744, 1927.

The author has re-investigated the M lines of the rare earths, using a vacuum spectrograph. To keep out the light from the incandescent kathode a celluloid film with an exceedingly fine coating of magnesium was employed. Hjalmar had previously observed no anomalies in the above lines, but the author finds that the compound doublet $M_{\alpha_1, \alpha_2, \beta}$ is deformed in these elements into an only partially resolved multiplet, the structure of which alters from element to element. This variation from the doublet character is shown to be connected with the completion of the electron group with principal quantum number four in passing through the group of rare earths. H. N. A.

117. The Relation between X-Ray Absorption Spectra and Chemical Combination. S. Aoyama, K. Kimura and Y. Nishina. *ZS. f. Phys.* 44. 11–12. *pp.* 810–833, 1927.

Contains the results of measurements of the K absorption spectra of a number of elements in various chemical combinations. By means of a cyclical process it is shown how the values of Δ (ν/R) for a number of the ions of these elements can be calculated from the ionising voltages, Δ (ν/R) being the shift of the K line with respect to that of the neutral free atom. Combining the results with those of observation the distances of the O^{--} ions from the ions S^{4+}, S^{6+}, Cl^{5+} and Cl^{7+} in certain salts can be calculated. Another cyclical process is used to show that the difference between the energies required to remove a K electron from XCl and from Cl^- is nearly equal to $u_1 - u_2$, where u_1 is nearly the same as the lattice energy per XCl molecule, and u_2 is the energy per molecule which would be required to bring all the ions X^+ back to their original positions in the lattice, with their electron shells in the original state, after the Cl^- ions have been removed. Other interesting points are discussed. H. N. A.

118. Intensity Relationships of Doublets with Large Frequency Differences. L. S. Ornstein, (Miss) M. Coelingh and (Miss) J. G. Eymers. *ZS. f. Phys.* 44. 9–10. *pp.* 653–654, 1927.

It is shown that the summation rules are valid for the *ps* and *pd* doublets in the borium spark if the observed intensities are divided by the fourth power of the emission frequency. It is possible that deviations from this rule occur, however, with greater frequency difference, as, for instance, in the case of thallium. W. V. M.

119. K-β-Lines of the Elements of the Iron Series. Part II. G. Ortner. *Akad. Wiss. Wien, Ber.* 136. 2*a*. No. 5–6. *pp.* 369–377, 1927.

Röntgen spectrograms of Co and Ni as elements show no resolution of $K\beta^1$ and $K\beta_1$, nor as complex ions such as in nickel potassium cyanide. With Co_3O_4, $CoCl_2$ and NiO, β^1 and β_1 are resolved. K, Ca, Ti and Va as elements and in combination were investigated and showed no difference between element and ion. With K, Ti and Va there appeared a shorter wave-length satellite between β^{11} and β_2. The meaning of the line β^1 is considered, and the possibility of several different configurations within the M_I M_{II} and M_{III} levels are suggested. Finally the X-ray results are compared with the critical potential results and the latest optical data.

J. E.

120. The Influence of Molecular Form and Polarity on the Röntgen Spectra of Liquids. Part I. Keesom's Relation. J. R. Katz. *ZS. f. Phys.* 45. 1–2. *pp.* 97–113, 1927.

In this paper an investigation is described for testing Keesom's relationship [see Abstract 1876 (1923)] found for certain liquids, *viz.*, that the diameter of the most intensive ring may be calculated from the molecular volume of the liquid. For extending the theory respecting the Röntgen spectra of liquids there is a great lack of data, and several hundreds of pure substances, whose molecular form is approximately known, have now had their Röntgen spectra determined for the liquid state and the connection with molecular form examined. Two limiting laws have been established, between which lie the other cases. H. H. Ho.

121. Fluctuations in the Absorption and Quantum Scattering of X-Rays. F. Kirchner. *Ann. d. Physik*, 84. 2. *pp.* 201–210, *Oct.* 4, 1927.

The tendency for the tracks of electrons produced by an X-ray pencil in cloud-chamber experiments to "group," as described by C. T. R. Wilson, is shown to be susceptible of explanation on purely statistical grounds, regarding the individual elementary processes as independent of each other. The law of distribution of electron tracks derived from measurements of a number of cloud-chamber photographs taken by the author is in agreement with the statistical theory. W. S. S.

122. The Azimuthal Distribution of Intensity for Scattered X-Radiation. W. Friedrich and G. Goldhaber. *ZS. f. Phys.* 44. 9–10. *pp.* 700–707, 1927.

A thin-walled trough filled with water was used as the scattering body, as the crystalline structure of solids may produce interference of the X-rays. Hard X-rays were passed through this trough and into an ionisation chamber with a gold-leaf electrometer mounted on a goniometer table. The experimental results were compared with the predictions of the Compton theory and with those of the formulæ of Jauncey, of Dirac and of Debye. The Compton curve fits the plotted values best, but that of Jauncey fits nearly as well. The differences are greater for the Dirac and still larger for the Debye curve. Some reasons for the differences between theory and experiment are suggested. H. N. A.

123. Dependence of the Total Intensity of X-Rays upon the Current Strength in the Tube. D. Nasledow and P. Scharawsky. *Phys. Zeits.* 28. *pp.* 625–632, *Sept.* 15, 1927.

The paper is a continuation of a previous paper [see Abstract 3142 (1927)], and, like this, is largely tabular. The total X-radiation intensities emitted from targets of copper, molybdenum, silver and tungsten were measured by means of a Siemens & Halske thermionic valve ionoquantimeter. The results were as follows: (1) The increase of total intensity with copper is governed by the same law as the increase of intensity of particular spectral lines, and in both cases there is a critical discontinuity at 4 mA. (2) In the cases of molybdenum and silver the results of previous experiments [see Abstract **3142** (**1927**)] were confirmed, and the critical discontinuity point was about 6 mA. (3) The critical discontinuity point of tungsten is about 8 mA. The authors conclude that for these elements the increase of intensity is the same both from the aspect of single characteristic lines or of the general radiation. B. J. L.

RADIOACTIVITY.

124. The Absorption Curve of High-Altitude Radiation in Water. L. Myssowsky and L. Tuwim.
ZS. f. Phys. 44. 4–5. *pp.* 369–372, 1927.

Measurements have been made at Balaclava, in Crimea, and the results, combined with those previously obtained in the Neva and Lake Onega in a curve. This curve corresponds to the absorption coefficient $(2\cdot 9 \pm 0\cdot 2) \,.\, 10^{-3}$ cm.$^{-1}$ for water. Certain misunderstandings relating to the authors' previous work are fully explained, and it is shown that the results agree satisfactorily with those of Millikan and of Steinke [see Abstract 2319 (1927)]. H. N. A.

125. Chemical Action of Penetrating Radium Radiation. Behaviour of Organic Compounds containing Nitrogen. A. Kailan.
Akad. Wiss. Wien, Ber. 135. 2*a*. *No.* 10. *pp.* 611–626, 1926.

A determination has been made of the ratio of the number of disintegrated molecules (m) and the number of pairs of ions (n) when radium γ-rays pass through various solutions of organic substances (containing nitrogen) in water. Thus m/n for uric acid in water $= 0\cdot 2$, for pyridine $= 0\cdot 3$, for aniline $= 0\cdot 4$, for p-introphenol $= 0\cdot 1$. A. B. W.

126. A Measuring Instrument for Strong α-Ray Preparations. H. Fränz.
ZS. f. Phys. 44. 11–12. *pp.* 757–761, 1927.

The measurement of strong α-ray preparations is attended by particular difficulties, and a method is now described based on differential ionisation and employing a guard-ring condenser. By its means zones and air equivalents are quickly measured and information readily obtained respecting the degree of homogeneity of any given α-radiation. H. H. Ho.

127. The Probability Law and the Emission of α-Rays. Measurements with Polonium. W. Kutzner.
ZS. f. Phys. 44. 9–10. *pp.* 655–683, 1927.

The author has previously shown that Bateman's probability law for the emission of α-particles does not in all cases agree with experiment [see Abstract 2114 (1924)]. The deviations from the law were greatest when the strength of the polonium preparation per unit of surface was large. Lawson ascribed these deviations to the fact that the preparations were uncovered, so that recoil phenomena could take place, while Bothe suggested that the resolving power of the apparatus used was insufficient. The author has now made a series of measurements in which the different preparations used were covered by a thin aluminium foil, and the recording of the time of emission of the α-particle was carried out in such a manner that it appeared very improbable that Bothe's suggestion could hold. The previous results were confirmed. It is not possible from the experiments to decide whether the disintegration takes place according to the laws of chance or otherwise, since the whole of the radiation could not be studied, but only a narrow beam could be sent into the Geiger counter.

H. N. A.

128. The Polarisability of Atomic Nuclei and the Origin of γ-Rays. W. Kuhn. *ZS. f. Phys.* 44. 1–2. *pp.* 32–35, 1927.

In a previous paper [see Abstract 2317 (1927)] it was opined that for certain frequencies in the γ-ray region the atomic nuclei might show a selective absorption. The present publication brings into relationship the polarisability of atomic nuclei with the existence of γ-ray spectra. From a consideration of the dimensional order of γ-ray frequencies and polarisabilities it appears probable that the particles which give rise to γ-ray spectra may be H or He nuclei and not the electrons bound in the nucleus.

H. H. Ho.

129. Atomic Disintegration Proved to Exist by the Wilson Method. R. Holoubek. *Akad. Wiss. Wien, Ber.* 136. 2*a*. *No.* 5–6. *pp.* 321–336, 1927.

A Wilson cloud chamber as modified by T. Shimizu was used, in which the piston was moved up and down by a motor 60 to 130 times per minute. This made it possible to perceive numerous H-particles without any strain on the eyes, such as exists in the scintillation method. The H-ray paths can also be photographed by means of a cimematograph camera coupled to the moving piston. Different dispositions of the polonium preparation and the substance which is disintegrated by the α-rays are described. The disintegration of carbon was confirmed, and the ratio 1 : 2 of the outputs for C and Al which was found agrees well with that obtained by other methods. It was shown that α-rays with a range of 2·2 cm. in air disintegrated Al, Be, C, O and Fe. The apparatus as used is more suitable for qualitative than for quantitative work.

H. N. A.

130. The Brightness of Scintillations Produced by H-Rays and the Possibility of Counting Them. Elisabeth Kara-Michailova. *Akad. Wiss. Wien, Ber.* 136. 2*a*. *No.* 5–6. *pp.* 357–367, 1927.

The apparatus was similar to that employed by Stetter in determining e/m for H-rays. These rays were passed through a magnetic field, which deviated them according to their velocity, so that only rays of the same velocity fell upon the portion of the ZnS-Cu screen which was observed microscopically. Two groups of trained observers were employed, and it was found that when the velocity of the H-rays was as low as 7×10^8 cm./sec. only 30 % of the particles actually present were observed on account of the faintness of the scintillations. The brightness was compared with that of scintillations produced by fast α-particles by using a microscope with two objectives and a single eyepiece, by means of which the screen excited by α-rays and that excited by H-rays could be viewed simultaneously. A continuous diminution of the brightness of the H-scintillations was observed from 10 to 2 cm. residual range, and a more rapid one from 2 to 0·7 cm. H-particles with a velocity of $v < \times 10^9$ cm./sec. cannot be counted with certainty.

H, N. A.

HEAT.

131. Transmission of Heat between Fluids and Partitions according to Modern Theory. A. Bernini. *N. Cimento,* 4. *pp.* 201–213, *May,* 1927.

In the first part of the paper, after a brief recapitulation of the progress made since Fourier in the study of the propagation of heat from fluid to fluid through a partition and the difficulty of determining the coefficient of external conductivity, allusion is made to recent researches which have led to the so-called theory of boundary strata or Prandtl's theory and to the attempts which have been made to coordinate and interpret experimental results in the light of the new theory. Hitherto these attempts have not been successful, so much so that whereas for the coefficients of transmission between aqueous vapour and partition, and between water and the same partition, the values should, according to the theory of boundary strata, be almost identical, a recent careful comparison of results gives values varying as one to six. In the second part the author gives an account of his researches into the cause of these discrepancies. His results, obtained with tubular partitions, while showing that the values hitherto found for these coefficients cannot be adduced as evidence against the theory of boundary strata, lead to the further conclusion that if certain sources of error, and notably the formation of gaseous bubbles adhering to the transmitting partition, be eliminated, the coefficients prove to be, in accordance with Prandtl's theory, of the same order of magnitude. E. F.

132. An Interferential Dilatometer Employing Automatic Photography. R. H. Sinden. *J.O.S.A. and R.S.I.* 15. *pp.* 171–177, *Sept.,* 1927.

A combination of the Fizeau interferential dilatometer with the Trowbridge method of interference fringe photography. Full details of the furnace used, the experimental operations, and the interpretation of the records. S. G. B.

133. Latent Heat of Evaporation of Sulphur. J. H. Awbery. *Phys. Soc., Proc.* 39. *pp.* 417–419 ; *Disc.,* 419–420, *Aug.,* 1927.

The latent heat of evaporation of sulphur was determined by finding the loss of weight of a vessel full of sulphur when energy was dissipated in it at a known rate. Heat losses were prevented by immersing the vessel in the vapour of sulphur. A method of correction for the heat loss by having a dummy vessel with a smaller heating coil, and using the differences in energy and in weight evaporated, for the two vessels, was tried but gave unsatisfactory results. The value found for the latent heat was 79, the accuracy being estimated at 2 %. AUTHOR.

134. Properties of Substances in the Condensed State at the Absolute Zero of Temperature. R. D. Kleeman. *Phil. Mag.* 4. *pp.* 257–268. *Aug.,* 1927.

A continuation and development of previous papers [see Abstract 2337 (1927)]. J. J. S.

135. Heat of Transformation of Nickel and Cobalt. S. Umino. *Tohoku Univ., Sci. Reports*, 16. *pp.* 593–611, *June*, 1927. *In English.*

By a calorimetric method the heat contents of nickel and cobalt at high temperatures were measured. From these results the mean and true specific heats at these temperatures were deduced, and the heats of magnetic transformation per gm. of nickel and cobalt were found to be 2·01 and 2·00 calories respectively. The heat of transformation in cobalt from the hexagonal close-packed lattice to the face-centred cubic was found to be 1·05 cal. per gm. of cobalt. AUTHOR.

136. A Micropyrometer. H. v. Wartenberg and H. Moehl. *Zeits. phys. Chem.* 128. 5–6. *pp.* 445–448, *Sept.*, 1927.

A new form of micropyrometer is described consisting essentially of a lens of short focal length (*f*. = 4 cm.) which gives a diminished image of the radiant source. The image is viewed through a simple small microscope of the type " Junior," by Spindler & Hoyer, whereby a magnification of one hundred is obtained. The filament of a 25-watt lamp for 220 volts was obtained sharply. The system is illustrated in a note appended on the results obtained with the instrument. A black body (9 × 2·8 cm.) in a platinum-wire oven was measured up to 1377° C. The relation between current strength and intensity was measured in a 1-ampere Nernst filament up to 1500° C. The black melting point temperature of platinum (Henning's value) was observed, *i.e.*, 1560° C. for $\lambda = 0{\cdot}656$. The melting point of molybdenum was measured and is given as 2600° C. + 30, experimental details for this determination being fully described. Various other points of interest are given showing the utility of the instrument.

S. G. B.

137. Flame. O. C. de C. Ellis. *Phot. J.* 67. *pp.* 349–357; *Disc.*, 358, *Aug.*, 1927.

A short account of the development of the knowledge of the nature of flame is followed by a summary of the author's results [see Abstracts 1459 and 1807 (1927)]. Reproductions of a number of photographs are given.

T. H. P.

138. Inflammation of Paraffin-Air Mixtures in a Closed Spherical Vessel. G. B. Maxwell and R. V. Wheeler. *Chem. Soc., J. pp.* 2069–2080, *Sept.*, 1927.

In previous experiments with methane-air mixtures, ignited at the centre of the spherical vessel, Wheeler [see Abstract 1262 (1918)] had observed maximum pressures 10 % lower than the values calculated on Langen's specific heat data. Tizard and Pye (Empire Motor Fuels Committee Report, 1923–24) found that heptane-air mixture gave nearly the calculated pressure values in engines. The new experiments are made in similar apparatus as before with methane, ethane, propane, butane and pentane, which all give similar pressure curves. The maxima increase in the order stated, and approach the calculated value more and more in that order. The observed maxima fall off more rapidly than the calculated as the hydro-carbon concentration increases from 2 to 14 %; the maxima are for methane near 10 %, for pentane near 3 %. The pressure loss is partly due to radiation, but to a greater extent to the low value previously assumed for the specific heat of steam (Bjerrum's value); between 100° and 2000° C. the specific heat of steam seems to lie between the values of Bjerrum 8·42 and Womersley 11·69 [see Abstract 1331 (1922)]. The extent of dissociation of the CO_2 was probably overestimated previously. Some of these probable errors would also affect the work of Tizard and Pye. The rate of pressure development would depend upon the calculated mean explosive temperatures. H. B.

139. Rates of Evaporation and the Vapour Pressures of Tungsten, Molybdenum, Platinum, Nickel, Iron, Copper and Silver. H. A. Jones, I. Langmuir and G. M. J. Mackay. *Phys. Rev.* 30. *pp.* 201–214, *Aug.*, 1927.

Langmuir and Mackay's data on the rates of evaporation of tungsten, molybdenum and platinum have been corrected to the tungsten temperature scale of Forsythe and Worthing. Similar data on nickel, iron, copper and silver are published for the first time on the same temperature scale. The third law of thermodynamics has been assumed in all calculations, and the vapour pressures are calculated from the rates of evaporation. The experimental data check the third law as shown by the constancy of the calculated values of λ_0, the latent heat of evaporation at the absolute zero. Tables are given of the rates of evaporation and the vapour pressures up to the boiling points. The data are compared with those of other investigators. The evaporation of metals heated in an atomic hydrogen flame was very rapid and gave results which confirmed the data on evaporation in vacuum. The values of λ_0 expressed in cal. gm. (atom)$^{-1}$ and the boiling points in degrees Kelvin are :—

	W.	Mo.	Pt.	Ni.	Fe.	Cu.	Ag.
λ_0	191,880	146,000	127,500	89,440	89,025	82,060	71,320
B.P. . .	6,970	5,960	4,800	3,650	3,475	3,110	2,740

AUTHORS.

140. Investigations on the Critical State. Part I. The Critical State of Water and Water Solutions. E. Schröer. *Zeits. phys. Chem.* 129 .1–2. *pp.* 79–110, *Sept.*, 1927.

An apparatus was developed and a method of investigating the critical state of water and of water solutions in the region of the temperature-density part of the diagram was worked out. The most probable value for the critical temperature of water was found to be 374·20° ± 0·20°. The entrance of the critical state was found to be independent of the degree of filling within the limits of 0·28 and 0·39. The densities of the gas and liquid phases were not equal when passing through the critical temperature. Homogeneity was first attained at about 0·5° higher temperature. If equality was brought about by stirring, a new difference was set up when the stirring ceased. The opalescence of water at the critical state was confirmed. Solutions of halogen salts of the alkali metals exhibited no linear relationship between the molar concentration and the rise of critical temperature, and the rise was different for different solutions of equal molar concentration. The relationship was found to be given by the equation. The curve for solutions in the temperature-density diagram is discontinuous, and shows a portion independent of the density. Coloured salts were found to require thorough mixing by stirring as the critical temperature was approached. Unless this was done very little salt was taken into the gas phase. The temperature at which the meniscus disappeared was the same in both cases. An explanation of the behaviour of solutions at the critical state was attempted. F. J. B.

141. A Computation of the Free Energy and Fugacity in Gaseous Mixtures of Ethylene and Argon. G. E. Gibson and B. Sosnick. *Am. Chem. Soc., J.* 49. *pp.* 2172–2179, *Sept.*, 1927.

The fugacities of ethylene and argon have been calculated by the authors from experimental data given by Masson and Dolley [see Abstract 1898 (1923)], who determined the isotherms of gaseous mixtures of ethylene and argon at pressures from 30 to 125 atmospheres. The results have been employed to test the rule of Lewis and Randall, that the fugacity of a constituent in a mixture of gases is the product of the mole fraction and the fugacity of the pure constituent at the pressure of the mixture. Up to about 50 atmospheres the rule holds fairly well, but between 50 and 100 atmospheres the errors range from 20 to about 100 %. Graphs are given showing the deviations from Lewis and Randall's rule. T. B.

142. Ultra-Violet Solar Radiometer. E. Pettit. *Nat. Research Council, Bull.* 61. *pp.* 101–108, *July*, 1927.

An ultra-violet recording radiometer consists of a thermocouple, which may be *in vacuo*, on which an image of the sun is alternately focussed in green and ultra-violet light by passing through gold and silver films. The relative constancy of the green radiation provides a check on the accuracy of the instrument. Readings are being taken at Tucson and Mt. Wilson. A. Wh.

143. Radiation from Interior of a Reflecting Cylinder. H. Buckley. *Phil. Mag.* 4. *pp.* 753–762, *Oct.*, 1927.

The author considers the radiation from the walls of a uniformly heated cylinder of emission ϵ and reflection factor $(1 - \epsilon)$. He determines the radiation from any point inside an infinite cylinder, multiple reflections being taken into account. The integral equation expressing the result is of the Poisson type and approximate solutions in the form of two-term exponential expressions are found for the cases $\epsilon = 0{\cdot}10$, $0{\cdot}25$, $0{\cdot}50$ and $0{\cdot}75$. These approximate solutions become exact at the end of the cylinder, where the radiation emitted per unit area is given by $\sqrt{\epsilon}\,.\,\sigma T^4$, ($\sigma$ is Stefan's constant). J. W. T. W.

144. Newton's Law for the Emission of Heat in Carbon Dioxide. Sybil Marshall. *Phys. Soc., Proc.* 39. *pp.* 429–434, *Aug.*, 1927.

This paper is an extension of the investigation, started by the author and J. O. C. Vick [see Abstract 2543 (1925)], of the justification of employing Newton's law of cooling when estimating the external heat loss from the surface of a solid in a gaseous medium. In this case, the loss in a vertical system, containing in turn CO_2, oxygen and nitrogen, was examined, the apparatus consisting of compensated platinum wires mounted along the axes of ice-water-cooled glass tubes and connected to the terminals of a Callendar-Griffiths bridge. The results show that, for tubes between 1 cm. and 3 cm. diameter, the law is applicable only as far as 10° C. for pressures between 1 atmosphere and 6 cm. mercury. The deviation above this temperature depends on the width of the tube and the density of the gas, being greater for CO_2 than for oxygen or nitrogen. AUTHOR.

SOUND.

145. Some Properties of a Hot Wire Microphone. O. Tugman. *J.O.S.A. and R.S.I.* 15. *pp.* 110–116, *Aug.*, 1927.

An electrically-heated fine platinum wire placed in the neck of a Helmholtz resonator has been used by Tucker and Paris in the construction of an instrument for measuring the intensity of sound. Another application of the hot wire has been demonstrated by Frieze and Waetzmann [see Abstract 342 (1926)]. It is here shown that the sensitiveness of the hot wire is a maximum for a heating current apparently limited by the construction of the apparatus. The maximum sensitiveness of any given wire is secured by a particular slit width. The change of resistance is a linear function of the intensity of the sound at the slit for any one frequency. The apparatus and method of measurement are described with the aid of diagrams. A. E. G.

146. Sound Meter. H. Barkhausen. *V.D.I.* 71. *pp.* 1471–1474, *Oct.* 15, 1927. *Paper read before the Elektrot. Verein, Dresden.*

Discusses the differences between physical and physiological intensity of sound and describes a form of sound meter for technical use. Details and practical examples are given. W. H. Ge.

147. A Reflexograph. W. Kaempfert. *Zeits. Instrumentenk.* 47. *pp.* 496–498, *Oct.*, 1927.

A device used in the study of audibility in buildings, which enables diagrams showing the reflection and interference of sound waves to be easily constructed. Three rods, two of which carry sliders, are linked together by levers and a cord in such a way that, if the direction of one of them is taken as that of a sound ray proceeding from the sounding body, and the second is placed tangential to a line on the paper which represents the contour of a reflecting portion of the building, the third will be in the direction of the reflected ray, and a pencil fixed to the slider on this rod will mark a point on a definite reflected wave front, which can thus easily be traced on the paper. H. N. A.

148. "Hearing" through the Sense Organs of Touch and Vibration. R. H. Gault. *Frank. Inst., J.* 204. *pp.* 329–358, *Sept.*, 1927.

The author discusses the possibility of assisting the totally deaf to understand speech through the vibrations transmitted to the skin by a form of telephone receiver held in the patient's hand. It is shown how, after a little practice, well-known phrases are easily recognised through the difference in feel of the vibrations transmitted. C. M. R. B.

149. Energy of the Struck String. Part II. W. H. George and H. E. Beckett. *Roy. Soc., Proc.* 116. *pp.* 115–140, *Sept.* 1, 1927.

This is a continuation of previous work [see Abstract 1825 (1927)], in which the influence of the initial velocity of the hammer, width and nature of the hammer face, and partition of energy among the various partial tones of the string are discussed. The effect is considered of the position of impact of the hammer and of the presence of a bridge. F. S.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

150. The Electron as a Vector Wave. C. G. Darwin. *Roy. Soc. Proc.* 116. *pp.* 227–253, *Sept.* 1, 1927.

The assumption is made that the wave of an electron has two components. The wave equations are worked out to fit the hydrogen spectrum and are unsymmetrical, and it is suggested that they should be interpreted in terms of a vector. A. Wh.

151. The Dynamics of the Electron. J. B. Pomey. *R.G.E.* 22. *pp.* 575–576, *Oct.* 15, 1927.

In a previous paper the author has dealt with the form of a flexible conductor, carrying a weak current, in the magnetic field produced by a very long rectilinear current [see Abstract 2961 (1927)]. He now treats mathematically the determination of the trajectory of a free electron in the same magnetic field; this problem is analogous to the former, but is distinct from it. H. N. A.

152. Wave-Mechanics of the Continuum and Electrodynamics. A. Landé. *ZS. f. Phys.* 44. 11–12. *pp.* 768–772, 1927.

Quantities such as energy density, impulse tension and stream density, which are exactly defined by the classical theory, are subjected to certain indeterminate limitations in the quantum theory. This leads to a wave function of the densities, which possesses four-dimensional space periods from the de Broglie standpoint, and is now considered for the case of electrodynamics. H. H. Ho.

153. Electrodynamics in Combination with the Einstein Theory of Gravitation. S. C. Kar. *Phys. Zeits.* 28. *pp.* 610–618, *Sept.* 1, 1927.

A new electrodynamical theory is presented, that by the acceptance of space-time rotation results in a seemingly complete, though quite simple, explanation of the Lorentz law of energy. To this theory is fitted in a natural manner the Einstein theory of gravitation. The work of Weyl, Eddington and Reichenbächer is considered. The author divides his paper into two parts. In the first part he develops his theory of electrodynamics totally independently of considerations of gravitation, and in the second part he shows how this theory can be combined with Einstein's theory of gravitation. J. K.

154. Electrical Separation between Identical Solid Surfaces. P. E. Shaw. *Phys. Soc., Proc.* 39. *pp.* 449–452, *Aug.*, 1927.

(1) When one insulating solid is rubbed along and perpendicular to an identical one they acquire charges $-^{ve}$ and $+^{ve}$ respectively. (2) Continued rubbing so affects the surfaces of "rubber" and "rubbed" that their properties change, with reversal of sign to $+^{ve}$ and $-^{ve}$ respectively. (3) The effect 2 is permanent unless the surfaces be restored by heat treatment. (4) Oblique impact of two identical solids generates on them unequal charges. The net charge is, in general, $-^{ve}$ AUTHOR.

155. Field Lines and Constant-Field Lines. G. Hauffe. *Zeitschr. f. tech. Phys.* 8. 9. *pp.* 362–365, 1927.

These are seldom identical in an electromagnetic field. The case of two infinitely long straight conductors is worked out, and the conditions for identity are ascertained. The results are tested by comparison with the known properties of homogeneous fields. A. D.

DISCHARGE AND OSCILLATIONS.

156. The Spark within the Electric Arc. M. Pierucci. *N. Cimento,* 4. *pp.* 252–262, *June,* 1927.

An illustration is given of a simple device whereby the spark produced by the discharge of a condenser is caused to flash in the interior of the arc. It shows itself as a true spark, making a longitudinal track through the arc. It is very bright and possesses a high degree of spectroscopic excitation, which is further enhanced when the arc is immersed in an atmosphere of illuminating gas. It produces notable mechanical and luminous effects on the positive crater of the arc, which, by reason of its action, is raised to a very high temperature. [See also Abstracts 1369 (1922), 905 (1923).] E. F.

157. Mechanism of the Arc Light. R. Seeliger and H. Schmick. *Phys. Zeits.* 28. *pp.* 605–610, *Sept.* 1, 1927.

Experiments on the arc light at different pressures show that the bright spot on the kathode in air and in nitrogen continually extends with decreasing pressure and that the current density at the spot decreases; at the same time the temperature of the kathode surface at the bright spot is smaller. This cannot be observed in neon, in which the bright spot is independent of the pressure and always remains the same. It was further found that the extension of the bright spot in air and nitrogen arcs with decreasing pressure does not continue, but that at a certain critical pressure (some cm. Hg) the form of the discharge with the extended bright spot takes on another form with a very small starting-place of the discharge at the kathode. [See also Abstract 1421 (1926).] A. E. G.

158. Small Mercury Arc of Great Brilliance. L. Dunoyer. *Rev. d'Optique,* 6. *pp.* 328–341, *Aug.,* 1927.

The author describes a small mercury vapour lamp specially designed for the illumination of slits. The light of the positive column serves as a source, while the length of the source is of the order of 2·5 cm. by 0·4 cm. diameter. The lamp is worked on a supply of 100 volts, and takes about 1·5 amperes with a pressure of 40 volts, between the electrodes. Along the axis of the positive column a brightness of 200 bougies per sq. cm. is obtained which may be almost 100 times as bright as the Cooper-Hewitt lamp in glass. The lamp is made of a hard, non-fusible glass of borosilicate. If made of quartz, a brightness from 250 to 560 times that of the Cooper-Hewitt lamp is obtained, but glass is more convenient and economic where the ultra-violet radiation is not required. R. S. R.

159. The Electric Discharge in a Liquid Medium. Part I. H. Obata. *Electrol. Laborat. Tokyo, Japan, Researches, No.* 202. [32 *pp.*], 1927.

160. Rotation of Electric Discharge. C. E. Guye and B. Luyet. *Arch. des Sciences,* 9. *pp.* 191–217, *May-June, and pp.* 247–263, *July-Aug.,* 1927.

The experiments described were made with the object of studying the effect of chemical decomposition on the velocity of rotation of an electric discharge in carbon dioxide, a first step in the study of the rotation of the discharge in gaseous mixtures. The second part of the paper gives results relative to the influence of the intensity of the discharge current on the velocity of rotation. The results are presented in a series of tables and diagrams and are discussed in their bearing on the determination of molecular diameters. A. W.

161. Theory of the Normal Kathode Fall in Glow Discharges. K. T. Compton and P. M. Morse. *Phys. Rev.* 30. *pp.* 305–317, *Sept.,* 1927.

From the principle of minimum energy dissipation it is shown that the actual potential distribution in the fall space must be that one which is most favourable to ionisation, subject to limitations imposed by Poisson's equation. With the aid of this principle, taking as known quantities the normal kathode fall V_n and Townsend's ionisation constants N and V_0, expressions are derived for the potential distribution, the thickness of the fall space d_n, the distribution of ionisation n_x and the current density j_n, which agree acceptably with experimental values. The most important results are given by the equations

$$pd_n = 0{\cdot}85\,\frac{V_n}{NV_0}\left(1 + \frac{V_0}{0{\cdot}97\,V_n} + \cdot\cdot\cdot\right)$$

$$\frac{j_n}{p^2} = 1{\cdot}85(10)^{-4}\left(\frac{L}{M}\right)^{1/2}\frac{(kN)^{5/2}V_n{}^{3/2}}{(1 - n_0/n_d)},$$

in which L, M and p are the molecular mean free path, the molecular weight of the positive ions, and the gas pressure. It appears that the normal kathode fall is found when the potential is distributed in the manner most favourable to ionisation, without restriction by space-charge considerations. When the current density exceeds the normal value, space-charge considerations require a less favourable potential distribution, and hence a larger kathode fall, which is the abnormal case. AUTHORS.

162. Intermittent Glow Discharge. E. Haak. *Ann. d. Physik,* 84. 1. *pp.* 119–153, *Sept.* 10, 1927.

An investigation was made of the periodic glow discharge in bulbs filled with a neon-helium mixture at about 10 mm. pressure and having unsymmetrical electrodes. Variation of the condenser in parallel with the discharge tube showed that the glow discharge is stable down to very small current densities. By reducing the parallel capacity as much as possible the static characteristic was obtained for very small currents. The dependence of maximum and minimum potentials on the frequency of intermittence, the charging current and the parallel capacity is shown in tables and diagrams. It was found possible to extend the frequency range for a certain lamp from 5000 to 7000 per sec. by the aid of a transverse magnetic field. Oscillographic studies were made of the potential changes at the electrodes; the curves were analysed to determine the relative strengths of the various harmonics. A simple arrangement is described for generating audible notes. A. W.

163. Molecular and Technical Penetration Field Strength of Solid Electric Insulators. A. Smekal. *Arch. f. Elektrot.* 18. *pp.* 525–535, *Sept.* 21, 1927.

The chief points dealt with in this paper are: The mechanical properties of solids; the electrical properties of solids; the loose structure of crystals of rock-salt; loose structure and the electrolytic conductivity in electric fields. A. E. G.

164. The Griffith Principle and the Penetration of Solid Dielectrics. G. E. Horowitz. *Arch. f. Elektrot.* 18. *pp.* 535–541, *Sept.* 21, 1927.

As Griffith has shown, the small mechanical firmness of solid bodies, which differ only slightly from ideal elastic bodies, can be explained through the presence on their surface of embryonic submicroscopic clefts. It is now pointed out that in the time-moment, when disruption results, the body is in a condition of labile equilibrium, and, consequently, its potential energy reaches a maximum value. With the calculation of the potential energy according to Griffith, the supplementary energy caused by the presence of clefts is taken into consideration. The present paper is mainly of a mathematical nature, and deals with the penetration of solid dielectrics on the assumption of the clefts described by Griffith. A. E. G.

165. Penetration of Porcelain at High Temperatures. Lydia Inge and A. Walther. *Arch. f. Elektrot.* 18. *pp.* 542–548, *Sept.* 21, 1927.

The authors claim that the results of their earlier work [see Abstract 1492 (1927)] make it clear that, in the case of homogeneous insulators, penetration at high temperatures must be explained by the theory of heat. It is now shown that in the case of porcelain at high temperatures there is a heat penetration. The absolute value of the penetration tension is determined from the material constants of the porcelain by means of the formula calculated by V. Fock, and is compared with observed results. The accord is considered satisfactory; discrepancies can be easily explained as due to defects in experimental arrangements. A. E. G.

166. Determination of Spark Constants. M. Toepler. *Arch. f. Elektrot.* 18. *pp.* 549–562, *Sept.* 21, 1927.

Doubt having been expressed as to the correctness of the values assigned to the spark constant by the author [see Abstract 200 (1927)], as well as attention having been drawn to some slight errors in the account then given, it was thought advisable to collect together the facts and extend the information relative to the determination of spark constants. Hence, in the present paper the following are the chief points dealt with: The course of the discharge taking into consideration the spark resistances; three experimental arrangements are each discussed in detail; the limiting case; the beginning of the sparks and their duration; the action of various types of antennæ; a criticism of the author's measurements of the spark constant. A. E. G.

167. Heats of Condensation of Electrons and Positive Ions on Molybdenum in the Gas Discharges. C. C. van Voorhis. *Phys. Rev.* 30. *pp.* 318–338, *Sept.*, 1927.

A new calorimetric method for measuring the electronic work function of a metal in a gas discharge is here developed. A small molybdenum sphere is supported in a region of intense gas ionisation by three fine wires, two of which form a thermocouple for measuring its temperature, while the third carries the current of the incoming ions. Space potential and mean electronic energies E_- are found by using the sphere as a Langmuir collector. Its rate of heating, due to an increment Δj in the electron current reaching it against a small retarding field, is measured and equated with small corrections to $\Delta j(E_- + \phi_-)$, whence the heat of electron condensation ϕ_- is found. The values of ϕ_- found by this method are: 4·76 volts in argon, 4·04 or 4·35 volts in hydrogen (mixed with argon), and 4·77 or 5·01 volts in nitrogen. The double values follow different treatments of the surface. By a modification of the method, ϕ_+ for an argon positive ion neutralised at a molybdenum kathode is found to be about 1 volt. The presence in a low-pressure gas discharge of the high-speed "secondary" electrons discussed by Langmuir. is shown by the good agreement between values of E_- obtained calorimetrically and values calculated from the $\log j_-$ against voltage lines of the two groups of electrons, as obtained by Langmuir's methods. [See also Abstract 1421 (1926).] A. E. G.

168. Diffusion of Slow Electrons (2-30 Volts) in Hydrogen and Argon. E. Zachmann. *Ann. d. Physik,* 84. 1. *pp.* 20–60, *Sept.* 10, 1927.

After a brief statement of the problem and a description of the apparatus and methods used, the following are the main points dealt with: Generation and measurement of well-defined slow electron bundles; action of electric and magnetic fields on the generation and course of the rays; the influence of the geometrical proportions of the apparatus; influence of the meeting of the elections with molecules of the gases and walls; diffusion results in hydrogen and argon; a comparison of the results obtained with those already known. A. E. G.

169. Shock Action of Slow Kations on Lithium Chloride in a High Vacuum. E. Badareu. *Phys. Zeits.* 28. *pp.* 634–637, *Sept.* 15, 1927.

It is generally known that canal rays falling on a metal call forth a secondary emission of electrons from it. The experiments of Ohlon and of Volker have also shown that canal rays cause a secondary emission of positive ions from certain salts when they fall upon them. In those experiments, however, neither the nature of the particles falling on the intercepting electrode nor their energy was definitely known. It seemed, therefore, advisable to examine the emission of positive ions from salts in cases where, on the one hand, the nature of the impinging ions is exactly known, and, on the other, their kinetic energy can be exactly measured. It is now found that the interception current in those cases where salts are used as intercepter are not very different from those obtained with metals except that the former is always smaller than the latter. It is also observed that the longer time the salt is left in the high vacuum the smaller is this difference. The current with metals shows no alteration with the time. The obtained results are in complete agreement with those of Volker. A. E. G.

170. Effect of the Medium on Gas Ion Mobility. H. A. Erikson. *Phys. Rev.* 30. *pp.* 339–356, *Sept.,* 1927.

Effect on the mobility of air ions of adding varying amounts of CO_2,

H_2, water vapour, C_2H_2, C_2H_4, Cl_2 and NH_3 to the medium.—In this paper results are given showing the effect on the mobility of adding foreign gases to the air through which the ions move. The conditions were such as to permit the use—at least initially—of identical air ions. It is shown that adding CO_2 and water vapour to the air diminishes the mobility, but adding hydrogen increases the mobility. The results also indicate that the change in the mobility is due to the change in the medium and not to a change in the ions. It is, however, found that increasing the relative humidity gives a larger proportion of initial or 1·87 ions, indicating that H_2O simplifies the final positive air ion. It is also shown that a trace of acetylene gives rise to an ion which has a mobility only slightly less than the initial air ion. It was also found that when acetylene remains in air a body is formed which, when it becomes charged, has a lower mobility. Results are also given showing that adding ethylene and chlorine to the air has no effect on the mobility within the time of observation used, whereas a trace of ammonia results in the formation of a single positive ion of the same mobility as that of the negative ion which is not affected.

AUTHOR.

171. Mobility of Ions in Mixtures of Gases. H. Mayer. *Phys. Zeits*. 28. *pp*. 637–644, *Sept*. 15, 1927.

Recent measurements of the mobility of ions in gas mixtures have established two important facts: (*a*) In certain cases there is a strong selective influencing of the mobility; (*b*) the mobility of negative ions in certain cases is clearly smaller than that of the positive; this has been observed by Loeb and also by the present author. In this paper the following points are investigated: (1) The influence of chlorine on the mobility of ions in pure and dry hydrogen. It is found that traces of chlorine less than 0·2 % pressure reduces the mobility of the negative ions below that of the positive. Increasing the amount of chlorine has less influence, but the mobility of the negative ions remains below that of the positive. (2) The influence of water vapour on the mobility of positive and negative ions in oxygen. (3) The mobility of ions in a mixture of hydrogen and oxygen.

A. E. G.

172. The Critical Tensions of Iodine. V. Kondratjew and A. Leipunsky. *ZS. f. Phys*. 44. 9–10. *pp*. 708–712, 1927.

In this paper a method is worked out for experiments on the critical tensions of multi-atomic gases, which allows the critical tensions of the molecule to be distinguished from that of the atom. An interpretation of the critical tensions of iodine obtained by this method is also given.

A. E. G.

173. Mean Free Path of Electrons in Ionised Mercury Vapour. K. B. Blodgett. *Phil. Mag*. 4. *pp*. 165–193, *July*, 1927.

By using a long tube with a heated kathode at one end and an accelerating anode, in the form of an open grid immediately in front of it, very long glows can be produced. With a low accelerating potential the glow comes to a termination at a definite length and the end is dome-shaped. By using Langmuir's method for investigating gaseous discharges the author has been able to obtain data leading to a revision of the theory of these glows, which it is shown provides a method for measuring the mean free path of the electrons in them.

F. S. B.

174. Photoelectric Ionisation of Mercury Vapour. F. G. Houtermans. *ZS. f. Phys.* 41. 8–9. *pp.* 619–635, 1927.

The ionisation of mercury vapour by light has been investigated by the method of Rouse and Giddings [see Abstracts 2745 (1925) and 2934 (1926)], whereby a quadratic relationship between nuclear ionisation and the resonance line λ2537 Å. has been established. Addition of argon produces reinforcement, although the smallest trace of hydrogen destroys the effect. It is concluded that the ionisation is simply proportional to the number of metastable atoms present. H. H. Ho.

175. The Rotation-Symmetrical Field of Radiation. Margarete Willstätter. *Ann. d. Physik,* 84. 1. *pp.* 163–166, *Sept.* 10, 1927.

Points out that Kiebitz's solution for wireless telegraphy [see Abstract 203 (1927)] is not a solution for wireless telegraphy at all but pertains to a particular problem of infinite conductors. A. D.

176. The Action of the Concentration Coil with the Braun Tube. H. Busch. *Arch. f. Elektrot.* 18. *pp.* 583–594, *Sept.* 21, 1927.

The author investigates the effects of electrostatic and magnetic fields in concentrating the kathode rays in a Braun tube. A magnetic field produced by a short, narrow coil, and therefore having a range which is small compared with the tube length, acts on the electron path exactly as a lens to light rays, the formula $\frac{1}{f} = \frac{1}{a} + \frac{1}{b}$ being similarly valid. An electrostatic field acts on the electron path as a medium of definite refractive index in optics. Investigations are carried out with a new form of tube, showing that much larger diaphragms can be employed, thereby increasing the luminosity of the fluorescent spot without impairing the sharpness. Thus with a diaphragm of 8-mm. aperture, a fluorescent spot of about 0·3-mm. diameter is produced, on which strikes an electron current of about 10 % of the tube current. E. T. A. R.

177. The Different Types of Oscillation which can be produced from an Electronic Tube by the Installation of Barkhausen and Kurz. N. Kapzov and S. Gwosdower. *ZS. f. Phys.* 45. 1–2. *pp.* 114–134, 1927.

This paper describes the experimental conditions under which electronic tubes with cylindrically arranged electrodes will produce at one time oscillations of the kind observed by Scheibe [see Abstract 961 (1924)] and at another time those of Gill and Morell [see Abstract 2444 (1922)]. Oscillations of both kinds have been obtained by means of one and the same tube. The properties of both oscillation types and deviations from the relevant theories have been established. From the experimental results it is concluded that both explanations for the origin of the oscillations are confirmed, and that accordingly in the installation of Barkhausen and Kurz [see Abstract 908 (1920)] two different oscillation mechanisms are in existence. The authors discuss the deviations between observed and calculated wave-lengths and conclude that the causes lie mainly in the variable lattice and anode tensions, and in the space-charge effect. The latter is calculated for a special case. H. H. Ho.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

178. Electric Resistance of Bismuth Solidified in a Magnetic Field. L. Tieri and V. Ricca. *N. Cimento,* 4. *pp.* 249–251, *June,* 1927.

When bismuth is solidified in a magnetic field the Hall effect is greater in the direction of the field than at right angles to it. This is explained on the assumption that the field tends to align the crystals with their principal axis parallel to the lines of force. On comparing the electric resistances of small cylinders of bismuth solidified in a transverse magnetic field and in the absence of the field it is found that the former show a resistance of about 4 % less than the latter, which agrees with the hypothesis. The directive action of the field is also revealed on examining the surfaces of fracture of the cylinders, of which four photographs are appended. E. F.

179. Electrical Insulating Materials. A. Güntherschulze. *Z. El. Ch.* 33. *pp.* 360–368; *Disc.,* 368–369, *Sept.,* 1927. *Paper read before the Deut. Bunsen Gesell., Dresden,* May, 1927.

The properties of the various insulating materials employed in the electrical industry were reviewed and discussed. The dielectric properties of gases, liquids and solids were contrasted. The influence of impurities, especially the presence of moisture, and the lowering of the dielectric strength of oil, was described. The consequence of dielectric losses and their effect on the insulating material were considered. In the *Discussion,* the necessity of investigations in the field of insulating materials by both chemists and electrical engineers was repeatedly emphasized. F. J. B.

180. Dielectric Constants of Dilute Electrolyte Solutions. R. Skancke and E. Schreiner. *Phys. Zeits.* 28. *pp.* 597–604, *Sept.* 1, 1927.

In the Wheatstone bridge high-frequency method of determining the dielectric constants of electrolytes there are various sources of error which are here investigated, and a method is worked out for eliminating them. Measurements are given. A. D.

181. New Form of Kathode-Ray Oscillograph. W. Rogowski, E. Flegler and R. Tamm. *Arch. f. Elektrot.* 18. *pp.* 513–524, *Sept.* 21, 1927.

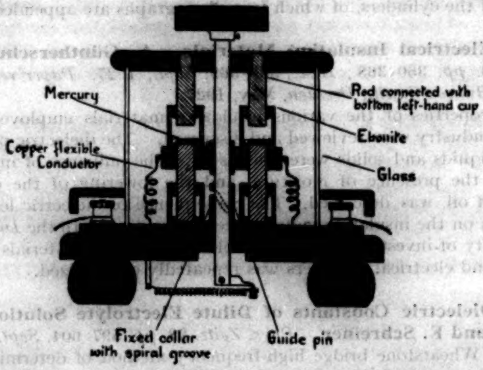
After an account of the steps by which the new arrangement has been arrived at, each important part of the apparatus is described in detail, and illustrated either diagrammatically or by photograph. Finally, a general view of the complete oscillograph is shown by a photograph. For details the original paper must be consulted. A. E. G.

182. Experimental Research on Electrostatic Voltmeters. E. H. W. Banner. *Journ. Sci. Instruments,* 4. *pp.* 388–390, *Sept.,* 1927.

The paper describes briefly various experimental work performed with the object of reducing the range of an electrostatic voltmeter. It was hoped to use water as the dielectric ($\epsilon = 80$) in order to increase the torque and so lower the full-scale voltage. The conductivity of distilled water was found to be far too high however. Methyl alcohol ($\epsilon = 34$) was also tried and abandoned for the same reason. Experiments were made on a cylindrical vane-type of electrostatic voltmeter in paraffin. Under certain conditions the scale increase for a given voltage was approximately proportional to the dielectric constant of the paraffin. Unless care is taken the mechanical properties of the liquid swamp the electrical force entirely. Another design of instrument with a constrained strip suspension was tried and found to have its calibration directly proportional to ϵ, the mechanical effects being eliminated. The reduction of voltage for full scale was, however, only $1/\sqrt{2}$, and hardly appreciable. AUTHOR.

183. Duplex Reversal Key with Mercury Contacts. E. A. Griffiths and Ezer Griffiths. *Phys. Soc., Proc.* 39. *pp.* 375–376, *Aug.*, 1927.

The key, shown in section in the accompanying figure, employs mercury contacts and is enclosed in a glass casing. The two upper fixed contacts consist of downwardly projecting copper rods, the two lower fixed contacts of cups containing mercury, and the two movable contacts of downwardly projecting copper rods, which enter the fixed cups in one position of the switch, surmounted by cups containing mercury which receive the fixed rods in the other position of the switch. The connections are those of a reversing switch, and the middle contacts can be raised or lowered by turning a vertical shaft which is retained in either position by a jockey spring. AUTHORS.


Mercury
Copper flexible Conductor
Rod connected with bottom left-hand cup
Ebonite
Glass
Fixed collar with spiral groove
Guide pin

184. Measurement of the Inductances of Four-Terminal Resistance Standards. L. Hartshorn. *Phys. Soc., Proc.* 39. *pp.* 377–387; *Disc.*, 387–388, *Aug.*, 1927.

The measurement of the effective inductances of "four-terminal" resistances of "shunts" is discussed. The method of measurement developed in the paper is an application of the Kelvin double bridge, used with alternating current, the phase-angle adjustment being obtained by condensers shunting the ratio arms. The procedure to be adopted for eliminating or evaluating corrections due to "leads" is described, and the advantages of the bridge in being free from stray fields, practically independent of frequency, capable of use with almost any desired current strength, and, moreover, very easy to work, are pointed out. Results of measurements made by this method on a series of typical shunts are recorded. AUTHOR.

185. Direct-Current Amplification, its Application to Measurements and its Limits. R. Jaeger and A. Kussmann. *Phys. Zeits.* 28. *pp.* 645–651, *Oct.* 1, 1927.

Methods of amplifying direct current are described and discussed with particular reference to their application to the measurement of very small currents and voltages. It is concluded that though valve arrangements may prove useful in the measurement of small currents they do not increase the accuracy of measurement. The measurement of very small d.c. potentials by such means is limited by disturbances, the principal origin of which is in the variations of the heating current of the valve filaments. Means are described whereby the disturbing effects can be largely eliminated and the sensitivity consequently increased considerably. A. W.

186. Measurement of the Vacuum in Electric Lamps. H. Alterthum and H. Ewest. *Zeitschr. f. tech. Phys.* 8. 10. *pp.* 407–410, 1927.

Follows up a method described by Selényi [see Abstract 2612 (1927)] for measuring residual gas pressure by applying a voltage between the glowing filament and a metallic surface on the outside of the glass bulb. Direct comparisons have been made of the pressure within the bulb and the ratio of the electronic to the ionic current. It is found that these two quantities follow each other sufficiently closely for the method to be used as an approximate gauge of the vacuum attained at any stage in the clean-up of a lamp. J. W. T. W.

ALTERNATING CURRENTS AND MAGNETISM.

187. Alteration of Resistance, Inductance and Capacity by Means of Resistance-Coupled Amplifiers. C. B. Aiken. *J.O.S.A. and R.S.I.* 15. *pp.* 85–95, *Aug.*, 1927.

Several schemes for the alteration of the effective resistance, inductance and capacity of a circuit employing a resistance coupled amplifier are discussed. It is shown to be possible to multiply the reactance of a circuit by a large factor, which may be made either positive or negative. Thus it is possible to neutralise the reactance of a circuit for all frequencies. Certain schemes are well adapted to the reduction of resistance, and as such may be divided into two classes: (1) those which are independent of frequency, suitable for the reduction of large resistances to a relatively small value; (2) those which are fairly insensitive to small frequency changes and are suitable for the annulment of small resistances. A. E. G.

188. Magnetic Susceptibility of the Iron-Carbon Alloys at High Temperatures and the Equilibrium Diagram of the System. K. Honda and H. Endo. *Tôhoku Univ., Sci. Reports,* 160. *pp.* 627–637, *Aug.*, 1927. *In English. Report No.* 170 *from the Research Inst. for Iron, Steel, and other Metals.*

The magnetic susceptibility of the iron-carbon system at high temperatures has been determined, and from the break or the discontinuity of the susceptibility-concentration curves, the solubility line of cementite, the solidus and the liquidus lines, and the eutectic horizontal have been drawn, and finally the equilibrium diagram of the system has been revised. AUTHORS.

189. An Exact Method for the Measurement of Magnetostriction. A. Schulze. *Arch. f. Elektrot.* 18. *pp.* 683–692, *Sept.* 21, 1927.

An application of the method of Whiddington to the measurement of magnetostriction. The magnetostriction is estimated by means of the alteration of the capacity in two high-frequency circuits. Whiddington has measured in this manner alterations of length of the order 10^{-8} cm. The paper is illustrated by illustrations of the apparatus and a wiring diagram. It is shown theoretically that if a rod of ferromagnetic material of length l is being investigated, and the distance apart of the condenser plates initially is d, then the relative alteration of capacity is

$$\frac{\Delta c}{c} = -\frac{\Delta d}{d},$$

and further

$$\frac{\Delta l}{l} = -\frac{d}{l} \cdot \frac{\Delta c}{c}.$$

The precautions necessary to secure a true and unvitiated striction effect are enumerated, and the calibration of the apparatus is fully described. The paper concludes with tables showing the application of the method to iron-nickel alloys for increasing nickel content from electrolytic iron to 99·2 % nickel. It is seen that dilatation maxima occur in the magnetostriction curves between 0 and 30 % nickel content and again between 30 and 81 %. With alloys containing more than 81 % nickel, as also with nickel alone, the value of $\Delta l/l$ is negative—*i.e.*, contraction results. The dependence of magnetostriction effects on previous treatment of the alloys is now being investigated. S. G. B.

190. Paramagnetism of the Families of Palladium and Platinum. B. Cabrera and A. Dupérier. *Comptes Rendus*, 185. *pp.* 414–416, *Aug.* 17, 1927.

Very little is known of the magnetic properties of the transition families II and III, of which the most characteristic elements are Ru, Rh, Pd, Os, Ir, Pt. It is foreseen that they are paramagnetic, and measurements have been made on the oxides and other compounds. There are indications that by using compounds of these types of salts paramagnetic moments comparable with those of the iron group may be obtained. These previsions apply to free atoms, but for combined atoms a modification of the paramagnetism must be expected on account of the action of the atoms with which they are connected. The authors have examined the chlorides of the six metals mentioned, which were prepared with care by W. C. Heraeus of Hanau, and independent values of χ, the specific susceptibility, at room-temperature, and of $\delta\chi/\chi$ within an interval of about 100 degrees have been obtained. The following table gives the values of the specific susceptibility, χ, and of the atomic susceptibility χ_a:—

	χ.	χ_a.
Ru^{+++}	$+ 95{\cdot}2 \times 10^{-7}$	$+ 1912{\cdot}0 \times 10^{-6}$
Rh^{+++}	$- 0{\cdot}825 \times 10^{-7}$	$+ 45{\cdot}5 \times 10^{-6}$
Pd^{++}	$- 2{\cdot}09 \times 10^{-7}$	$+ 3{\cdot}38 \times 10^{-6}$
Os^{++}	$+ 1{\cdot}58 \times 10^{-7}$	$+ 82{\cdot}75 \times 10^{-6}$
Ir^{+++}	$- 0{\cdot}48 \times 10^{-7}$	$+ 47{\cdot}2 \times 10^{-6}$
Pt^{++}.......	$- 2{\cdot}18 \times 10^{-7}$	$- 17{\cdot}4 \times 10^{-6}$

The results obtained for $\delta\chi/\chi$, which are somewhat complex, are also discussed in the paper. J. J. S.

191. Precision Method for the Measurement of Magnetic Permeability for High-Frequency Oscillations. L. Sokolow. *Ann. d. Physik,* 83. 8. *pp.* 1136–1160, *Aug.* 25, 1927.

The high-frequency resistance and internal self-induction, R and L_i, lead to two values of the magnetic permeability, different owing to hysteresis effects. R and L_i are measured, using an improved form of a method due to Wuckel [see Abstract 1285 (1924)], in which the current distribution is determined along a Lecher wire system having an artificial continuation to avoid reflected waves. For constantan wires the calculated and measured values of R agreed to within ½ %. For iron wires the two permeabilities were measured in the wave-length range 3·2 to 10·9 m. The maximum in the permeability wave-length curve (permeability from R) observed by Kartschagin, although clearly indicated, is less well developed than for Kartschagin. W. S. S.

192. Method of Obtaining Strong Magnetic Fields. P. Kapitza. *Roy. Soc., Proc.* 115. *pp.* 658–683, *Aug.,* 1927.

In further developing a previously described method of obtaining strong magnetic fields [see Abstract 2502 (1925)], with a view to obtaining still stronger fields, accumulator batteries are replaced by a specially designed single-phase a.c. generator of the turbo-alternator type, a half-cycle only of the current being brought into use. The amplitude of the current employed reaches 72,000 amperes, the voltage being 2250 volts. Owing to impedance and other causes, only 55,000 out of a total of 220,000 kW are available for the production of a magnetic field. A special switch and timing arrangement for governing the power supplied to the coil are described. The difficulties encountered in designing a coil capable of standing over 250,000 gauss are described in detail, but a design involving, *inter alia,* the use of pure copper strengthened by the addition of 2 % Cd and a slipping contact capable of carrying a current of 30,000 amperes is described which successfully withstands the powerful unwinding and bursting effort exerted by 320 kilogauss in a volume of 2 c.c. A direct method of measuring magnetic fields of short duration with ballistic galvanometers is given. A. B. C. L.

193. Magnetic Susceptibility of Some Binary Alloys. J. F. Spencer and (Miss) M. E. John. *Roy. Soc., Proc.* 116. *pp.* 61–72, *Sept.* 1, 1927.

Measurements of susceptibility were made with a Curie-Chéneveau balance [see Abstract 374 (1904)] on binary alloys of gold with lead, tin and cadmium, lead with silver, tin and bismuth, and tin with aluminium and cadmium. The field employed was 640 gauss, and the values found for the pure metals were in satisfactory agreement with those of Owen and Honda. The change of mass susceptibility with composition is shown by graphs and in tables. In the gold-lead series the maximum susceptibility is paramagnetic, although both constituents are diamagnetic. In the aluminium-tin series the component elements are paramagnetic, but all the alloys examined were diamagnetic. The susceptibility-composition curve for lead-tin follows a linear course with no indication of intermediate compounds. The alloy with 70 % of tin is non-magnetic. G. E. A.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

194. An Experimental Test of the Gibbs Absorption Theorem. A Study of the Structure of the Surface of Ordinary Solutions. J. W. McBain and G. P. Davies. *Am. Chem. Soc., J.* 49. *pp.* 2230–2254, *Sept.*, 1927.

An attempt is made to confirm somewhat directly by the measurements of adsorption in and near the surface of solutions a suggested definite conception of the structure of the surface of ordinary solutions as deduced from several kinds of evidence. The work of others in this field is fully considered, and all the results by the Donnan and Barker method are rejected. The authors describe a new and simple method devised by them for determining the absolute adsorption in the air-water interface, and the quantitative results obtained for the aqueous solutions of *p*-toluidine, amyl alcohol and camphor are shown to be trustworthy. For these ordinary non-electrolyte solutions it is concluded that "the surface consists of a saturated monomolecular film of solute resting upon a comparatively thick layer of concentrated solution, gradually falling off with depth to the bulk concentration of the liquid." A mechanical explanation of this structure is advanced, and it is shown further why the numerous data calculated by means of the Gibbs concentration formula are in error. J. K.

195. Heats of Adsorption on Poisoned and Heat-Treated Catalysts. G. B. Kistiakowsky, E. W. Flosdorf and H. S. Taylor. *Am. Chem. Soc., J.* 49. *pp.* 2200–2206, *Sept.*, 1927.

A series of measurements of the heat of adsorption of hydrogen on active and heat-treated copper catalysts were made. The results showed that a maximum of heat of adsorption was obtained with active preparations when the heat of adsorption was plotted against amount adsorbed. Partially activated catalysts showed a maximum when smaller amounts of gas were adsorbed. When further de-activated the maxima disappeared. The results were found to be in harmony with a theory of the catalytic surface with variable elementary spaces, upon the most active of which the adsorption is accompanied by an endothermic activation process. F. J. B.

196. Density of Solutions of Sodium in Liquid Ammonia. C. A. Kraus, E. S. Carney and W. C. Johnson. *Am. Chem. Soc., J.* 49. *pp.* 2206–2213, *Sept.*, 1927.

A specially designed apparatus in which a Westphal balance works in a stream of H is described and illustrated. The densities of solutions of Na in liquid NH_3 determined at − 33·8° C. at concentrations ranging from 32·6 mols. per atom of Na up to the saturation point are found to be lower than the density of either constituent. From the density values obtained the increase in volume accompanying the solution of Na in liquid NH_3 is calculated. The volume increase amounts to 40·96 c.c. for a saturated solution, increasing with increasing dilution to a maximum of 43·14 c.c. for a solution containing 11·2 mols. of NH_3 per atom of Na. On further dilution the value gradually diminishes and apparently approaches a limiting value in the neighbourhood of 40 c.c. At − 33·8° the saturated solution contains 5·48 mols. of NH_3 per atom of Na.

A. B. C. L.

197. Influence of the Magnitude of the Interstices on the Selective Permeability of Membranes. (Miss) Choucroun. *Comptes Rendus*, 185. *pp.* 502–505, *Aug.* 29, 1927.

Measurements are recorded of the p.d. developed in liquid couples $HCl—H_2O$, $KCl—H_2O$ separated by "acid" gelatine gels at 2 % and 6 % concentration and $KHO—H_2O$, $KCl—H_2O$ separated by "alkaline" gels at the same concentrations, and a reversal of sign in the case of the "alkaline" gels is noted, indicating a retarded diffusion of H^+ ions with respect to the Cl^- ions in spite of the much greater mobility of the former.

It is suggested that a knowledge of the various causes influencing the selective permeability of membranes, particularly by the ions H^+ and OH^-, may be of considerable importance in biology. A. B. C. L.

198. Diffusion in the Gravitational Field. R. Fürth. *ZS. f. Phys.* 45. 1–2. *pp.* 83–85, 1927.

Weaver's objections [see Abstract 2800 (1927)] to the author's previous calculation of the rate of sedimentation [see Abstract 1560 (1927)] have only been partly confirmed. All the earlier conclusions drawn by the author from his work on the sedimentation of colloidal solutions are now found to be valid. H. H. Ho.

199. Dependence of the Avogadro number on the Magnitude of the Particles. S. Ray. *Zeits. phys. Chem.* 128. *pp.* 182–188, *Aug.*, 1927.

Various considerations render it improbable that the Avogadro number is independent of the size of the particles. The values obtained for this number by Perrin by a method in which use is made of Brownian movement are invariably higher than Millikan's values deduced by a procedure which eliminates any effect due to the magnitude of the molecules. The suggestion that the latter may account for this disparity is supported by the results obtained by Porter and Hedges [see Abstract 392 (1923)]. T. H. P.

200. Velocity of Solution and Electrolytic Solution Pressure of Lead and Bismuth. J. Groh. *Zeits. phys. Chem.* 128. 5–6. pp. 449–458, *Sept.*, 1927.

The velocities of solution of lead and bismuth were determined by measuring the change in concentration of amalgams and the solutions in contact with the amalgams, the solutions were stirred at a constant rate during the experiment. The results obtained were in agreement with the general theory. F. J. B.

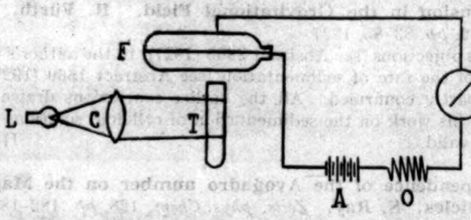
201. Ionic Mobility in Mixture Crystals and its Relation to that in Pure Salts. C. Tubandt, H. Reinhold and W. Jost. *Zeits. phys. Chem.* 129. 1–2. pp. 69–78, *Sept.*, 1927.

The ionic mobility in mixture crystals has been determined, and its relation to that in the pure salts has been found for various concentrations by means of measurements of conductivity and of transference of the ions electrolytically. In this way an accurate measure of the degree of strengthening or of loosening of the bonds produced in a crystal lattice by the entrance into it of ions of a different kind has been obtained. The knowledge of these mobility relations makes it possible to judge with certainty how far the diffusion coefficients obtained by means of measurements of diffusion in mixture crystal systems (the indicator method) represent the auto-diffusion coefficients of the pure salts, and, when this is not the case, supplies the means by which these coefficients can be calculated. H. N. A.

202. New Method for the Investigation of Colloid Systems.

N. N. Andrejew. *Kolloid Zeits.* 43. *pp.* 14–17, *Sept.*, 1927.

The scattering of light brought about by a colloidal solution is measured by means of a potassium photo element as illustrated in the figure. The vessel T, which contains the liquid under measurement, is illuminated by the source L, which produces a light cone by means of the lens C. The scattered light from the vessel T passes into the photo element F. A battery of 45 volts is employed at A in series with a resistance of 10,000 ohms, and the ionisation current is measured by the mirror galvanometer G. The apparatus is calibrated by employing a 0·027 % solution of mastic. With increasing concentration of different colloids, a limiting value is reached for the scattered light due to increasing absorption by the upper layers, and at high concentrations, the values fall in some cases. Measurements are made during the precipitation of colloidal sulphur by the action of hydrochloric acid on sodium thiosulphate, and of the coagulation of mastic by an electrolyte. Reference is made to possible applications of the apparatus. J. N. P.



203. Constitution of Cobalt-Nickel and Cobalt-Iron Alloys.

A. Schulze. *Zeitschr. f. tech. Phys.* 8. 10. *pp.* 423–427, 1927. *From the Reichsanstalt.*

Guertler and Tammann found in 1904 that the melting curve of Co-Ni alloys is practically a straight line between the melting points of the two metals, the solidus and liquidus keeping close to one another, and that the curve of magnetic transformation (Ni near 550°, Co near 1120°) is of similar character. This was confirmed by Ruer and Kaneko [see Abstract 1772 (1912)]. From the study of the physical properties of cobalt Masumoto (1926) concluded the existence of a further magnetic transformation point near 400°. The author determines the electric conductivity and its temperature coefficient, at ordinary temperature, of Ni-Co alloys containing from 10·2 to 99·2 % of Co, made in the shape of rods (300 mm. long, 6 mm. diameter) by Krupp in Essen. The two curves are very similar and show peaks at 20, 60, 80 atomic per cent. of

Co, which would correspond to the compounds Ni$_4$Co, Ni$_3$Co$_2$, NiCo$_4$. The same peaks appear in the curves of magnetostriction and thermal expansion. Masumoto's curves showed only one peak at 80 % Co; the difference may be due to the different thermal treatments of the specimens. The Co-Fe alloys had likewise been studied by Guertler and Tammann, Ruer and Kaneko and Masumoto. The author takes similar measurements on fourteen specimens (prepared as mentioned), ranging in Co from 12·6 to 99·2 %. The electric resistance curve shows two sharp peaks near 50 and 66 % atomic of Co (corresponding to FeCo and FeCo$_2$), and further two minor peaks, one near 33 % Co(Fe$_2$Co) and another doubtful one near 40 %. The curve of Honda [see Abstract 1240 (1919)] shows the same general trend, but not the peaks, because the respective alloys were not especially studied by him. H. B.

204. Mathematical Methods of Frequency Analysis of Size of Particles. Part II. Application to Silver Bromide Precipitates. R. P. Loveland and A. P. H. Trivelli. *Eastman Kodak Co. Research Lab., Comm. No.* 300. *Frank. Inst., J.* 204. *pp.* 377–389, *Sept.,* 1927.

Part I [Abstract 3028 (1927)] of this investigation contained a method of size-frequency analysis, and it was shown that in the analytical study of a series of dispersed particle systems, simple graphical methods may be highly efficient and all that is necessary for certain purposes. This work is now extended to the examination of thirty-three precipitates by double log analysis and the method of normal function, fluctuations and discontinuities in the frequency curves being discussed. It is found that in a chemical precipitation of silver halide the whole distribution of particles is not governed by a single-frequency law. H. H. Ho.

205. X-Ray Study of the β-Transformation in Copper-Zinc Alloys. A. Phillips and L. W. Thelin. *Frank. Inst., J.* 204. *pp.* 359–368, *Sept.,* 1927.

The β-transformation of copper-zinc alloys was studied by means of a specially designed furnace, and X-ray photographs were taken at high temperatures. The conclusions arrived at as the result of the experimental results were that the lattice of the β-brass is body-centred, and that the parameter increases with the zinc content. β-brasses containing 51·1 % and 50·4 % copper have lattice constants d_{100}2·956 Å. and 2·974 Å. respectively. β-brass above the transformation temperature (or range) is also body-centred. At 520° C. its parameter is 3007 Å. F. J. B.

206. Some Physical Properties of Cobalt. A. Schulze. *Zeitschr. f. tech. Physik.* 8. 9. *pp.* 365–370, 1927.

The electric resistance, the temperature-coefficient, the thermic expansion and the thermoelectric properties of a specially pure sample of cobalt examined up to high temperatures. An allotropic change sets in between 400° and 500° C. A. D.

207. Distortion of Crystals of Aluminium under Compression. G. I. Taylor. *Roy. Soc., Proc.* 116. *pp.* 16–60, *Sept.* 1, 1927.

The changes in the orientation of crystal axes during compression of a disc cut from a single crystal of aluminium are discussed; they are in accordance with the assumption that the slipping of the crystal may be determined by distortion measurements. As in the case of tensile test pieces, crystal axes always take up a position where two possible planes of slip are symmetrically disposed in relation to the stress, but in this case the orientation of the crystal axes relative to the normal to the flat surfaces of the specimen is quite different from their orientation relative to the axis of the tensile test piece. After the axes have taken the symmetrical position, Laue photographs show that they remain there even when distortion is very great. Tests were continued till the thickness of the specimen was only 0·23 its original thickness. Distortion during the period when the crystal axes remain in the symmetrical position is due to slipping on two symmetrically disposed planes of slip. The bearing of the results on the structure of rolled metal is discussed, and distortions of cubical blocks of material, due to various types of double slipping, are compared to find out which is most likely to occur. Experiments were carried out to find out whether it were possible to measure the internal shearing stresses in a compressed disc. Equations are developed for analysing shear stresses parallel to planes of slip and distortion due to double and single slipping. The relationship between shear stress and amount of shear, when slipping is confined to one plane, is identical for tensile and for compression specimens. During double slipping resistance to shear increases more rapidly for a given total amount of slipping than when all slip is confined to one plane. Resistance to shear goes on increasing up to very great amounts of distortion, the greatest used. [See also Abstract 2736 (1926).] A. D.

208. Reduction of Alumina, etc., by Tungsten at High Temperatures. H. v. Wartenberg and H. Moehl. *Zeits. phys. Chem.* 128. 5–6. *pp.* 439–444, *Sept.*, 1927.

The oxides of aluminium, zirconium and thorium were reduced by metallic tungsten at temperatures above 2000° C. in nitrogen. The oxides were mixed with starch paste and formed into a rod 2-3 mm. thick, and pierced with a hole into which a tungsten wire was inserted. The rod was sintered in an oxyhydrogen flame and then placed in the windings of the heating spiral of the furnace. Excessive radiation was prevented by a molybdenum shield. The reduction is dependent upon the vaporisation of the oxides and the formation of WO_3 in the form of vapour. F. J. B.

209. Least Energy Required to Ignite Mixtures of Air and Ethyl-Ether Vapour. Y. Nagai and M. Furihata. *Imp. Acad. Tokyo, Proc.* 3. *pp.* 352–354, *June*, 1927.

The least condenser-discharge spark energy required to ignite a series of mixtures of air and ethyl-ether vapour is measured in an apparatus similar, with slight modifications, to that described by W. A. Bone and F. R. Weston [see Abstract 1944 (1926)]. The results obtained at 760 mm. are expressed graphically, and show that with condenser charges up to 100 volts the least energy for ignition decreases rapidly over the ethyl-ether concentration range of 2·5 % to 3·9 %, remaining constant to 4·7 %. Further concentration causes a rise until the concentration reaches 5·0 %, whence it is again constant to 5·9 %, afterwards rising sharply. When the voltage of the condensers is raised, the concentration of the first constant stage is extended on both sides, resulting in the narrowing of the range of the second constant stage, the latter vanishing when the condensers are charged to 200 volts. A smaller energy is required at the higher voltages owing to the smaller cooling effect of the poles resulting from the longer spark gap. Measurements made at 500 mm. are tabulated, and indicate that the value for the concentration corresponding to the sudden change of the least energy is not a function of the pressure but of the voltage of the condensers. A. B. C. L.

210. Some Factors influencing the Ignition of Carbon Monoxide and Oxygen. A. K. Brewer. *Nat. Acad. Sci., Proc.* 13. *pp.* 689–694, *Sept.*, 1927.

W. A. Bone [see Abstract 1944 (1926)] showed that if sufficient energy is given, combination can take place between perfectly dry carbon monoxide and oxygen. The present research was undertaken to find whether this result is due to some higher stage of ionisation, or whether it is simply dependent on the introduction of a given amount of energy. It is concluded that the latter is the true explanation. It is found that the combustion of the explosive mixture dried by H_2SO_4 seldom goes to over 10 % completion. Curves are given showing that $v = h/P$, where v is the applied voltage and P the pressure of the explosive mixture. The effect of various impurities other than water on the energy of ignition of the explosive mixture is also investigated, the impurities investigated being of two classes, (1) those which increase the ignition potential, *e.g.*, argon, nitrogen, alcohol, ether; (2) those which decrease it, such as water, hydrogen, carbon disulphide. In the second class are also placed alcohol and ether, provided sufficient oxygen is added to burn them completely. T. B.

211. Passivity of Iron Mirrors. Part I. H. Freundlich, G. Patscheke and H. Zocher. *Zeits. phys. Chem.* 128. 5–6. *pp.* 321–344, *Sept.*, 1927.

Vapour of iron carbonyl is admitted into an evacuated glass tube, which should be warm, and which is then heated to 240°. Deposition of iron begins at about 170°, sometimes even at 100°. The mirror is translucent, brownish-grey in transmitted light, not free of holes under the microscope; the ultra-microscope shows only a few diffraction discs. Debye-Scherrer X-ray examination indicates crystallites of α-iron. The mirror dissolved completely in hydrochloric acid and sulphuric acid and could only contain very little impurity (carbon). Mirrors of thickness 16 to 63 $\mu\mu$ had a specific conductivity of $1 \cdot 5$ reciprocal ohm—about one-seventh that of compact iron—but there were disturbing transition resistances. The structure is disperse. In the blow-pipe the metallic mirror turns into an iridescent oxide mirror. The metal mirrors oxidise in water and air, but remain intact in bichromate sulphuric acid, which only dissolves them at 110°. The mirrors are rendered passive by contact with concentrated nitric acid (density $1 \cdot 42$) like passive iron wires, but could not then be activated, like iron wire, by contact with active iron in acid of $1 \cdot 40$. This, however, applies only to vacuum mirrors which had been protected from all contact with air; but contact with carbon dioxide, nitrogen and water did not affect the vacuum passivity. Vacuum mirrors are soluble in concentrated nitric acid and in test acid ($1 \cdot 20$). Air mirrors (that had been exposed to air) only dissolved in test acid. But care should be exercised in admitting acid into the vacuum tube; there was first almost instantaneous dissolution of the mirror, followed with thicker deposits by a period, sometimes of days, of further very slow dissolution. The air passivity can sometimes be destroyed by heating in a vacuum, but not simply by pumping. Sometimes the treatment with nitric acid leaves an insoluble brown film on the glass. The phenomena are explicable on the oxidation theory of passivity. H. B.

212. The Photosynthesis of Naturally Occurring Compounds. I. The Action of Ultra-Violet Light on Carbonic Acid. E. C. C. Baly, J. B. Davies, M. R. Johnson and H. Shanassy. *Roy. Soc., Proc.* 116. *pp.* 197–211, *Sept.* 1, 1927.

No measurable reaction takes place when pure carbonic acid in aqueous solution, free from all suspended matter, is exposed to ultra-violet light, but a very definite reaction occurs when there is present in the solution a surface capable of absorbing the carbonic acid. A photo-stationary state is established, involving as one of its components a complex carbohydrate. Formaldehyde, when found, appears to arise from the photochemical decomposition of complex products. Ferrous bicarbonate in aqueous solution is converted by ultra-violet light in the absence of oxygen into ferric hydroxide, organic compounds with reducing properties being simultaneously formed. This reaction appears to take place mainly on the surface of the quartz tubes in which the solution is exposed to the light and also on the surface of the iron rods used. Materials which are effective as adsorbing surfaces in this synthesis are aluminium powder, barium sulphate, freshly precipitated aluminium hydroxide, and the basic carbonates of aluminium, magnesium and zinc. After remaining in contact with water for some hours, aluminium hydroxide loses its efficacy, and this is due to the well-known fact that it then has no measurable affinity for carbonic acid. Since the experimental details were identical in this case with those when the other powders were used, this result excludes the possibility that the results observed in the other cases were due to impurities. The total quantity of organic compound produced is about 0·02 gm. in two hours when eight quartz test tubes 9 in. × 1 in., containing in all 720 c.c. of water and the suspended powder, are exposed to the light from a 220-volt U-shaped lamp at an average distance of 6 cm. In the presence of ammonium bicarbonate complex organic compounds are produced which contain nitrogen. Photosynthesis of complex organic material containing nitrogen also takes place when nitrate of potassium or barium is present. J. N. P.

213. Photosynthesis of Carbohydrates from Carbonic Acid by Means of Visible Light. E. C. C. Baly, W. E. Stephen and N. R. Hood. *Roy. Soc., Proc.* 116. *pp.* 212–219, *Sept.* 1, 1927.

When carbonic acid, adsorbed on the surface of nickel or cobalt carbonate suspended in water, is exposed to visible light, photosynthesis of organic compounds takes place. One at least of the products of this photosynthesis is a carbohydrate. For equal areas of the suspension exposed to the light the yield of organic products is greater than that obtained with white powders in the light of the quartz mercury lamp. The percentage of carbohydrates in the products photosynthesised with a coloured surface in white light is greater than it is when white powders are used in ultra-violet light. If ammonium bicarbonate solution containing nickel or cobalt carbonate in suspension is exposed to visible light complex nitrogen compounds are photosynthesised. The shift in the exciting wave-length from the ultra-violet characteristic of carbonic acid in solution to the visible region characteristic of natural photosynthesis has been achieved in the laboratory. The photosynthesis by means of visible light has the advantage in that the photochemical decomposition of the products is avoided. The oxygen set free during the photosynthesis tends to poison the surface. When moist nickel and cobalt carbonates are exposed to visible light in an atmosphere of carbon dioxide a surface film of Ni_2O_3 and Co_2O_3 respectively is formed. The surface, when poisoned by oxygen, slowly recovers itself under water, with the result that increased yields of the carbohydrates are obtained with unit quantity of light when the intensity of illumination is decreased. When the surface has become completely poisoned the photosynthetic process ceases, and then with intense illumination the carbohydrates previously formed are photochemically decomposed. J. N. P.

214. Photosynthesis in Vivo and in Vitro. E. C. C. Baly and J. B. Davies. *Roy. Soc., Proc.* 116. *pp.* 219–226, *Sept.* 1, 1927.

A marked similarity exists between photosynthesis *in vivo* and that now recorded as having been achieved *in vitro*. This is established by the following features which appear to be common to both. Ordinary formaldehyde does not take part in the reaction in either case. The laboratory process has been realised by the action of light on carbonic acid adsorbed on a surface. There seems little doubt that a limiting surface exists in the chloroplast and is necessary for the photosynthesis to take place. A visibly coloured surface and visible light function in each of the two processes. A marked fatigue effect is observed when the living leaf is exposed to too long and intense illumination, and very intense illumination destroys the chlorophyll. In the laboratory a similar fatigue effect, due to poisoning of the surface by oxygen, is observed. Intense and prolonged illumination destroys the carbohydrate, there being present nothing which is analogous to the chlorophyll. In both processes there is a slow recovery reaction, and it appears that in both the photosynthesis must not proceed at a more rapid rate than that recovery reaction. It follows that in the living leaf the presence is to be expected of some internal mechanism which controls the rate of photosynthesis so that it does not exceed that of the slow recovery reaction. It is suggested that the orientation of the chloroplasts with respect to the direction of the light rays is one of the details of this mechanism. J. N. P.

215. Action of Light on Chlorine. G. B. Kistiakowsky. *Am. Chem. Soc., J.* 49. *pp.* 2194–2200, *Sept.*, 1927.

The amount of light absorbed by moist chlorine is not altered by drying the gas, whilst only a very small proportion of this absorbed light can be re-emitted as fluorescence. To reconcile these experimental results with the known influence of moisture on the Budde effect, it is suggested that chlorine is dissociated into atoms on absorption of light energy in the region of continuous absorption and that this dissociation is independent of the presence of impurities. Water is assumed to have a catalytic influence on the rate of recombination of the atoms and therefore on the rate of thermal dissociation of chlorine molecules. L. M. C.

216. Nature of Activated Molecules. L. J. Waldbauer and I. J. Patton. *J. Phys. Chem.* 31. *pp.* 1433–1434, *Sept.*, 1927.

A theoretical paper criticising the radiation hypothesis of chemical reaction as held by Frautz, Perrin, Lewis and others. The authors agree with Dushman that it is not necessary to assume a radiation mechanism for bimolecular reactions, but disagree with him for assuming such an assumption necessary for monomolecular reactions, since, it is pointed out that, outside radioactive disintegrations, the very existence of monomolecular reactions is extremely problematical. The authors explain the existence of active molecules by considerations of the Bohr atom, wherein the electrons move in elliptical orbits, with the nucleus at one focus, their velocity being least at the outer portions of the ellipse. "Activated" molecules are those characterised by their valence electrons being at their greatest distance from the nucleus. J. K.

217. Influence of Hydrogen on Homogeneous Aldehyde Reactions. C. N. Hinshelwood and P. J. Askey. *Roy. Soc., Proc.* 116. *pp.* 163–170, *Sept.* 1, 1927.

When a molecule in a gaseous reaction receives by collision the energy necessary for chemical change, its transformation may be immediate, or may be delayed and only take place after the molecule has passed through some internal phase. With immediate transformation the rate of the reaction is simply the rate at which energy can be communicated, and the reaction is kinenatically bimolecular. When there is delay, the energy gained in a first collision may be lost in a second one, and if the average interval between collisions is small compared with the time lag between receipt of energy and transformation, the reaction will appear to be unimolecular. A time lag after activation is most probable with complex molecules with energy distribution along a number of degrees of freedom. With simple activation mechanics, absence of time lag may be expected. The decomposition of propionic aldehyde, and of dimethyl and diethyl ether [see Abstracts 1936 and 2787 (1927)] seemed to be unimolecular above certain pressure limits; at lower pressures the rate of reaction fell off. In the presence of moderate amounts of hydrogen the two ether reactions mentioned remained unimolecular at low pressures. Experiments are made with propionic aldehyde at 523° C. and initial pressures ranging from 40 up to 271 mm. and hydrogen pressures from 0 to 800 mm. This aldehyde is found to behave like the ethers as regards hydrogen, that is to say, the rate falls off when the pressure of the reacting gas is sufficiently reduced, indicating an influence of molecular collisions. But the bimolecular decomposition of acetaldehyde is less influenced by hydrogen, and no saturation value is reached. This would confirm the conclusions that the activities of acetaldehyde involves no time lag, and that the transformation concerns only a few degrees of freedom, whilst the case of propionic aldehyde is more complex and involves a time lag. H. B.

218. Cells of the Standard Type with Low Electromotive Forces. W. C. Vosburgh. *Am. Chem. Soc., J.* 49. *pp.* 2222–2229, *Sept.*, 1927.

The results obtained for measuring the electromotive forces over a period of several months at 25° C. and also at 5° intervals from 15° C. to 40° C. of the cells

$$\mathrm{Cd(Pb\,.\,Hg)\,|\,CdCl_2\,.\,2\,.\,5H_2O,\ sat.\,|\,CdCl_2\,.\,2\,.\,5H_2O + PbCl_2,\ sat.\,|}$$
$$\mathrm{Pb(Hg)\ and\ Cd(Pb,\,Hg)\,|\,Cd1_2,\ sat.\,|\,Cd1_2PCl_2,\ sat.\,|\,Pb(Hg)}$$

are given. Reference is made to the work of Gerke [see Abstract 592 (1923)] and the experimental results are compared with those obtained by Obata, and by Taylor and Perrott. The chloride electrolyte cell from the temperature-electromotive relation has a transition temperature between 26° C. and 27° C., thus preventing this cell being suitable as a low-voltage standard cell. Again, the iodide cell shows marked and persistent hysteresis, and both have large temperature coefficients. Experimental details are given and thermochemical data are made use of for calculating the heats of reaction. J. K.

219. Valency and Addition Compounds. J. Perrin. *Comptes Rendus*, 185. *pp.* 557–561, *Sept.* 12, 1927.

The author feels bound to assume that all reactions $A \rightarrow A'$ decompose according to the following elementary reactions: *activation* (endothermic) of the molecules of the system A; *association* of the molecules of the system a thus obtained into an addition molecule α; *dissociation* of this molecule α into molecules a'; then the *de-activation* of the system a' giving A'. A bimolecular reaction, for example, is analysed as follows:—

$$\begin{matrix} A_1 \rightarrow a_1 \\ A_2 \rightarrow a_2 \end{matrix} \qquad a_1 + a_2 \rightarrow \alpha \qquad \alpha \rightarrow a'_1 + a'_2 \qquad \begin{matrix} a'_1 \rightarrow A'_1 \\ a'_2 \rightarrow A'_2 \end{matrix}$$

Upon this theory of chemical reactions he suggests the relations between light and matter should be developed. An attempt is made to indicate how the orthodox views on the structure of the atom can be brought into line with the modern electrical hypothesis, wherein the atom is comparable to a solar system. The stability and inactivity of the argon group of elements is also discussed from the point of view of electronic arrangement. The electronic structure of the ions of Cl^-, K^+, Fe^{++}, Fe^{+++}, Zn^{++} is considered, and the value of partial valency theories is estimated. The author considers that there is much to be conserved in the old ideas of valency. J. K.

220. Continuous Method of Electro-Conductivity Titration. E. Butterworth. *Manchester Phil. Soc., Mem.* 71. *pp.* 53–62, *June* 6, 1927.

An electric circuit is described whereby an alternating current (from a triode valve arranged as an oscillator) causes a potential difference across the terminals of a titration cell. This voltage is applied to the grid of a detector valve, and in the detector circuit is included a galvanometer. Addition of acid to an alkaline solution in the titration cell causes a change of voltage across the electrodes, and this is at once recorded on the galvanometer. This continuous record is one of the main advantages claimed for the apparatus as compared with a.c. Wheatstone bridge methods. Other advantages are that the current through the cell is of fairly pure wave form and is approximately constant, and that there are none of the usual phase difficulties. The apparatus has been used for various acidimetric titrations and for the titration of silver nitrate with potassium thiocyanate solution. L. M. C.

221. New Method of (Absolute) Potentiometric Titration. B. Cavanagh. *Chem. Soc., J. pp.* 2207–2216, *Sept.*, 1927.

A method is devised for the titration of the ions $H^\cdot$, $Ag^\cdot$, OH', Cl', Br' and I' by the use of a cell consisting of a hydrogen electrode and a silver chloride electrode in the same solution. A single vessel may thus be used without a liquid junction. The e.m.f. of a cell of this nature in presence of hydrogen and chlorine ions at the concentrations C_H and C_{Cl} is given by the equation: $E = E_0 + 0 \cdot 05735 \log (C_H \times C_{Cl})$. Alternatively, one of the ions may be removed from the solution by means of a standard reagent and the end point indicated by means of a galvanometer. According to which ion is being titrated, the end point occurs when either C_H reaches the value of the ionisation product of water, or C_{Cl} reaches the value of the solubility product of silver chloride. An alternative simple method is to immerse a smooth platinum electrode and a silver wire coated electrolytically with silver chloride in a solution containing hydrogen ions, chlorine ions and a little quinhydrone. The potential concentration relation with this system is given by the equation: $E = 0 \cdot 4740 + 0 \cdot 05735 \log A_H A_{Cl}$, where A_H and A_{Cl} are the "corrected concentrations" or activities. In presence of saturated silver chloride E becomes zero when $C_H = 5 \cdot 6 \times 10^{-4}$. The indication of this stage of acidity as the end point can therefore be effected by the use merely of a pair of electrodes and a galvanometer. J. N. P.

222. Conductivity of Acids and Salts in Liquid Ammonia. F. A. Smith. *Am. Chem. Soc., J.* 49. *pp.* 2162–2167, *Sept.*, 1927.

The particular object of the investigation was to ascertain whether or not metallic salts derived from the ammonia system would ionise in liquid ammonia to a greater extent than their respective acids. Measurements of some twenty compounds (alkali salts and their acids) were made at $-33 \cdot 5°$ in cells of the Elsey type, differing little from those of Franklin and Kraus, by means of a telephone and alternating current of 1000 cycles; the whole apparatus was shielded with grounded metal, and the specific conductivity of the solvent (to be deducted) was redetermined before and after each series of measurements. The observational errors may reach 5 % in some cases. Few of the curves correspond more than approximately to the dilution law of Kraus and Bray; the substances thus do not behave like simple binary electrolytes. The dilution was carried to $\log v = 5$; at $\log v = 4 \cdot 5$ most of the curves showed an inflection. The alkali salt proved mostly to be a better conductor than the acid, but the difference was small with strong acids. The acid amides were found poor conductors, as expected from their analogy to carboxylic acids; although they are dibasic, only one hydrogen atom can be replaced by potassium in liquid ammonia solution. The mercury salt of succinimide behaves like mercury salts in general and shows very low conductivity in ammonia as in water. The conductivity of the ammono-carbonic acids and their alkali salts increases with de-ammoniation of the acid and decreases with polymerisation. Sulphur nitride is a good conductor and behaves like a binary electrolyte; it appears to be a mixed an-ammonide of ammono-sulphurous acid and ammono-thiosulphuric acids. H. B.

223. Source of Error in Conductivity Measurements. F. A. Smith. *Am. Chem. Soc., J.* 49. *pp.* 2167–2171, *Sept.*, 1927.

The author supports the conclusion of Washburn and of Schlesinger and Read that conductivity cells should be used only for solutions having resistances of the order of magnitude of the solution cells used to determine the cell constant, because the cell constant changes with the resistance of the solution measured. In the experiments three-electrode cells of Elsey were used. The electrodes are three co-axial open cylinders, two concentric and close together, the third at some distance from the others, presenting its edge to the other edges; either the concentric pair or a distant pair is coupled up. Experiments are made with ammonium nitrate or chloride dissolved in water and in ammonia, and with potassium chloride in water. Doubling the resistance of the solution between the concentric pair of electrodes more than doubled the resistance between one concentric and the distant electrode. This effect amounted to about 5 % at a dilution of about 1000 litres per mol., and increased with dilution up to the highest resistance that could be measured between the distant pair of electrodes. H. B.

224. Electrolytic Conductivity of Glass with High Field Strengths. F. Quittner. *Akad. Wiss. Wien, Ber.* **136.** 2*a*. *No.* 3–4. *pp.* 151–173, 1927.

The conductivity of the ordinary instrument glass and of Schott's glass 1447/III was investigated at temperatures from 20° C. to 52° C. and with high strengths of field, with which the conductivity is actually raised. The conductivity was found to be *purely electrolytic.* It is proved by titration with 10^{-3} norm. acid and iodine-eosin as indicator that Faraday's law holds for the multitude of metal ions wandering out from the glass in watery solution. Thus is made, depending on this method, a coulomb meter of great accuracy. By previous treatment with 10^{-2} norm. K_2SO_4 solution as anode, a layer can be produced with Thuringian glass from which with reversal of the current no alkali wanders out. After long passage of the current in this direction the migration of Na increases so that the earlier condition of Na-migration can be almost completely attained. The percentage of the Na ion-migration from Na_2SO_4 solution in glass 1447/III increases with rising concentration of the solution. From 1 norm. Na_2SO_4 solution Na-ions migrate corresponding approximately quantitatively to Faraday's law. J. J. S.

225. The Electrolytic Conduction of Rock-Salt Calculated by Means of a Lattice Theory. W. Braunbek. *ZS. f. Phys.* **44.** 9–10. *pp.* 684–699, 1927. *Arch. f. Elektrot.* **19.** *pp.* 115–122, *Nov.* 3, 1927.

The theory is based on the assumption that electrolytic conduction in a crystal is due to change of place by the ions, as supposed by v. Hevesy. The thermal movements in the lattice are idealised in a very similar manner to that employed by the author in obtaining a theory of the melting of crystals, and formulæ are derived which are based on the classical statistical probability that a harmonic linear oscillator (a sodium ion) has an energy between ϵ and $\epsilon + d\epsilon$ when there is temperature equilibrium. From this the probability is calculated that the energy is greater than ϕ, the threshold energy, which is the energy which will carry the ion to the centre of one of the surfaces of the octahedron surrounding its rest position, at the corners of which the nearest six Cl atoms are situated. The Cl atoms are supposed to remain permanently in these positions. The probability of jumps outside the octahedron is calculated, and finally a formula is obtained for the conductivity κ, $\log \kappa = 27 \cdot 7 - 10400/T$. Seelen's measurements for temperatures up to 500° C. give $\log \kappa = 25 \cdot 5 - 10700/T$. The second constant is nearly identical in these two formulæ, while the difference between the two values of the first constant is not large. H. N. A.

226. Behaviour of Certain Metals in the Electrolysis of Water by Alternating Current. A. P. Rollet. *Comptes Rendus*, 185. *pp*. 457–460, *Aug*. 22, 1927.

In the electrolysis of water by an alternating current passing between metal electrodes disengagement of gas does not take place except above a given density of current. Shipley and Goodeve in America have reached the same conclusion, and they call the density of current for which the gases appear the critical density. The author has found that: (1) The density of current at which gas is produced does not depend on the alternating e.m.f. Whatever may be the alternating p.d. applied, the critical density of current must be attained before bubbles of gas appear. (2) For a given electrode surface the density of current characterising the appearance of bubbles of gas increases up to a limiting value as the concentration increases. This limiting value is very rapidly attained with small electrodes, more slowly with electrodes of large surface. J. J. S.

227. The Alkali Chloride Industry. J. Billiter. *Z. El. Ch.* 33. *pp*. 353–360; *Disc.*, 360, *Sept.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May*, 1927.

The author reviews the present position of the alkali chloride industry, especially from the electrochemical standpoint. The various cells employed and the results obtained are contrasted, and the economics of the different processes are discussed. F. J. B.

228. Corrosion of Metals as an Electrochemical Problem. A. Thiel. *Z. El. Ch.* 33. *pp*. 370–386; *Disc.*, 387–388, *Sept.*, 1927. *Paper read before the Deut. Bunsen Gesell., Dresden, May*, 1927.

The earlier work on the electrolytic corrosion theory was reviewed and discussed. Measurements on the rate of solution of zinc and aluminium in 0·05 N hydrochloric acid and in N caustic soda respectively were made. The rate of solution of zinc in acid was determined alone and in the presence of other metals by passing a measured current and collecting the hydrogen which was evolved. The condition of the corroded surfaces was examined microscopically. The results were discussed from the standpoint of the " local element " theory of corrosion. F. J. B.

229. Electrolytic Reduction and Reactions in the Glow-Arc at the Phase Boundary Liquid Gas. A. Klemenc. *Zeits. phys. Chem.*, 130. *pp*. 378–389, *Oct.*, 1927.

Following a comprehensive introduction, the author then gives a very detailed description of an exhaustive experimental study of electrolytic reduction whereby the entire products of electrolysis are investigated. The behaviours of the following solutions are studied: aqueous sulphuric acid, ferrous sulphate in sulphuric acid, ferric sulphate in sulphuric acid, and alkaline nitrate. The conclusion is drawn that hydrogen separated electrically can bring about reduction without the intermediate presence of a hydrogen-metallic phase. The reaction variations are in each case described for reductions in the presence of the glow-arc. H. H. Ho.

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